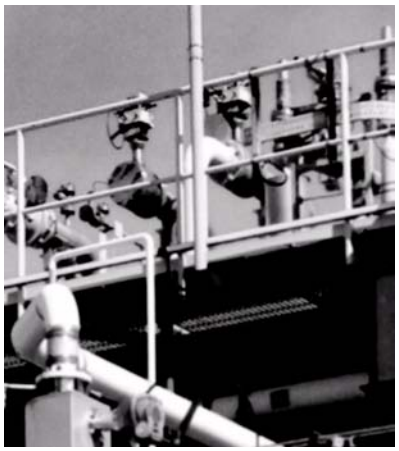
Reference Manual

Allen-Bradley

PlantPAx Process Automation System

System Release 2.0



PlantPAx
Process Automation System

Allen-Bradley • Rockwell Software

Rockwell Automation

Important User Information

Solid-state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation® sales office or online at http://www.rockwellautomation.com/literature/) describes some important differences between solid-state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid-state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

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	ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
	SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

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This manual revision concentrates on the implementation recommendations that apply to all PlantPAx systems. Information not specific to the PlantPAx system or focused on system procurement was removed.

New and Updated Information

This table contains some of the changes made to this revision.

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Core control components have been split into two sections:	
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Chapter 7, Maintenance Recommendations, has been added to assist with maintaining and monitoring your PlantPAx system.	67

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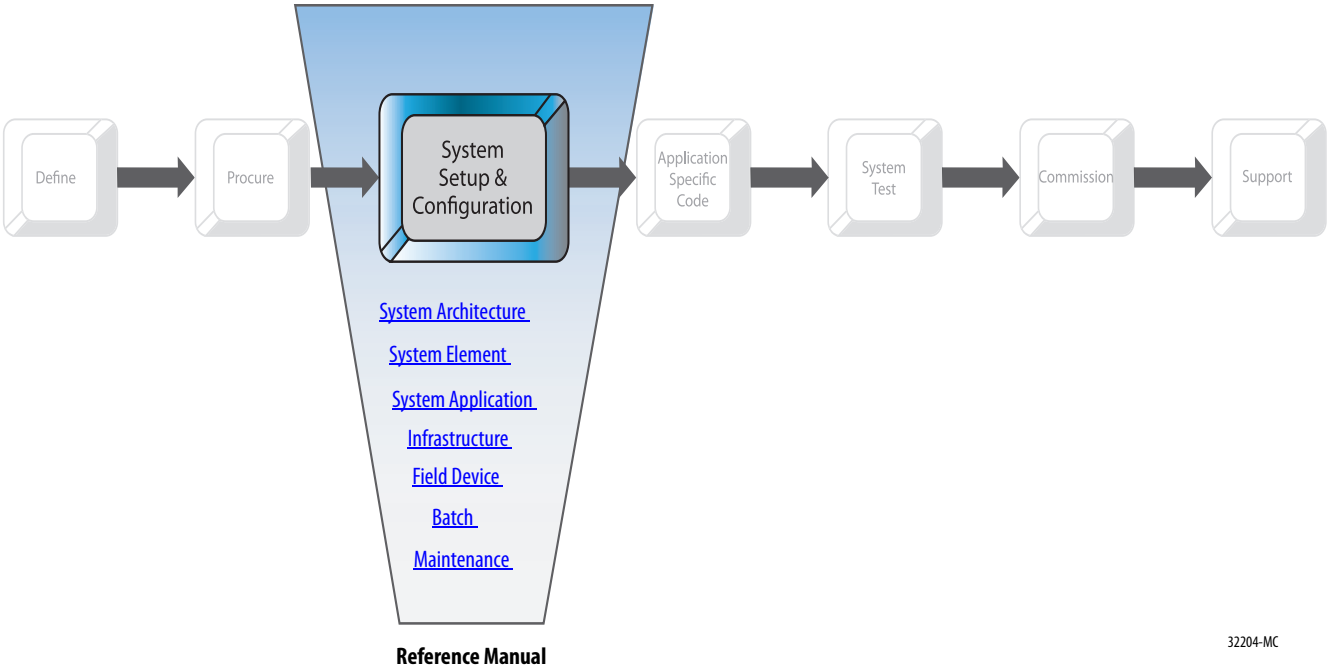
Notes:

The PlantPAx™ Process Automation System is a defined set of standard Rockwell Automation Integrated Architecture products that are configured in a prescribed way to provide optimal performance as a process automation system. When combining PlantPAx core system components, tools and utilities, with other Rockwell Automation and partners products, the result is unmatched automation system flexibility, scalability, and expandability when solving continuous batch as well as high-speed discrete applications.

Whereas the PlantPAx Selection Guide is used to assist with equipment procurement after defining system requirements, this Reference Manual elaborates on what you need to know to set up a PlantPAx system (as shown in Figure 1).

Figure 1 - Reference Manual Scope



The Reference Manual content is organized in logical order—from configuring system elements to developing applications.

You do not need to read the sections in sequential chapter order. If you already have configured workstations and servers—for example, defining the required FactoryTalk® Directory—you can skip to other sections, such as network and field device recommendations.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Table 1 - Additional Documentation

Resource	Description
System Core	
FactoryTalk View SE Edition User Manual, publication VIEWSE-UM006	Provides details on how to use this software package for developing and running human-machine interface (HMI) applications that can involve multiple users and servers, distributed over a network.
FactoryTalk View SE Installation Guide, publication VIEWSE-IN003	Contains procedures for installing FactoryTalk View SE software.
FactoryTalk Alarms and Events System Configuration Guide, publication FTAE-RM001	Provides details on how to install, configure, and use FactoryTalk Alarms and Events services as part of a FactoryTalk-enabled automation system.
ControlLogix System User Manual, publication 1756-UM001	Explains how to use traditional and extreme environment ControlLogix controllers.
ControlLogix Enhanced Redundancy System User Manual, publication 1756-UM535	Provides information on the installation and configuration for an enhanced redundancy controller system for greater availability.
Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094	Details how to design and optimize Logix5000 controller applications.
Logix5000 Controllers Common Procedures Programming Manual, Publication 1756-PM001	Provides links to a collection of programming manuals that describe how you can use procedures that are common to all Logix5000 controller projects.
Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003	Provides programming controller applications by using relay ladder instructions.
Logix5000 Controllers Advanced Process Control and Drives Instructions Reference Manual, publication 1756-RM006	Provides details on process control and drives instructions.
Logix 5000 Controllers Execution Time and Memory Use Reference Manual, publication 1756-RM087	Provides a complete listing of all instruction execution time and memory usage information for Logix5000 controllers, firmware revision 18.11 (except ControlLogix 1756-L7*x* controllers that use firmware revision 18.12), in your RSLogix 5000 programming software, version 18.00, program.
1756 ControlLogix Controllers Technical Data, publication 1756-TD001	Contains specifications for ControlLogix controllers.
PlantPAx Server and Workstation User Manual, publication 7477-UM001	Explains how to configure prepackaged PlantPAx servers and workstations.
Infrastructure	
PlantPAx Process Automation System Selection Guide, publication PROCES-SG001	Provides an overview of the three typical process architectures: independent, centralized, and distributed.
EtherNet Design Considerations Reference Manual, publication ENET-RM002	Explains the infrastructure components that allow this open network to communicate seamlessly throughout a plant, from shop floor to top floor.
Ethernet-to-the-Factory 1.2 Design and Implementation Guide, publication ENET-TD001	Provides collaborative design guidelines based on the Cisco Ethernet-to-the-Factory solution and the Rockwell Automation Integrated Architecture solution.
Stratix 8000 and 8300 Ethernet Managed Switches Software User Manual, publication 1783-UM003	Details how to configure and maintain managed switches.
ControlNet Coax Media Planning and Installation Guide, publication CNET-IN002	Provides procedures for planning, installing, and implementing a ControlNet network.
ControlNet Fiber Media Planning and Installation Guide, publication CNET-IN001	
ControlNet Modules in Logix5000 Control Systems User Manual, publication CNET-UM001	
Field Device Integration	
FactoryTalk AssetCentre Installation Guide, publication FTAC-IN004	Provides installation instructions for monitoring your factory automation system.
FactoryTalk AssetCentre Product Profile, publication FTALK-PP001	Explains this tool for securing, managing, versioning, tracking, and reporting automation-related asset information across your entire enterprise.

Table 1 - Additional Documentation

Resource	Description
1756 ControlLogix Communication Modules Specifications Technical Data, publication 1756-TD003	Contains specifications for the ControlLogix network communication modules.
Ethernet Design Considerations Reference Manual, publication ENET-RM002	Explains the infrastructure and components for the EtherNet/IP protocol, a control and information platform for industrial environments and time-critical applications.
EtherNet/IP Modules in Logix5000 Control Systems User Manual, publication ENET-UM001	Explains Logix5000 tools that are used in EtherNet/IP topologies and network operation.
FOUNDATION Fieldbus System User Manual, publication 1757-UM012	Publications provide design, configuration, and specifications for fieldbus devices and the 1757-FFLD and 1757-FFLDC linking devices.
FOUNDATION Fieldbus Design Considerations Reference Manual, publication RSFBUS-RM001	
FOUNDATION Fieldbus Linking Device Technical Data, publication 1757-TD003	
ControlLogix HART Analog I/O Modules User Manual, publication 1756-UM533	Contains information on how to install, configure, and troubleshoot ControlLogix HART analog I/O modules.
Promass 83 Flowmeter via PROFIBUS PA to the PlantPAx Process Automation System, publication PROCES-AP022	Provides procedures for the design and implementation of PROFIBUS PA equipment.
DeviceNet System Quick Reference, publication DNET-QR001	Provides procedures for configuring applications on the DeviceNet network.
CENTERLINE® Motor Control Centers with EtherNet/IP, publication 2100-TD031	Publications detail the EtherNet/IP network that offers a full suite of control, configuration, and data collection services.
Batch	
PhaseManager User Manual, publication LOGIX-UM001	Explains how to define a state model for your equipment and develop equipment phases.
FactoryTalk Batch Installation Guide, publication BATCH-IN011	Provides information and procedures for installing FactoryTalk Batch software.
FactoryTalk Batch User's Guide, publication BATCH-UM011	Provides a complement of FactoryTalk recipe management, component guidelines, and software installation procedures.

You can view or download publications at http://www.rockwellautomation.com/literature. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Notes:

System Architecture Recommendations

The PlantPAx Process Automation System is a defined combination of standard Rockwell Automation Integrated Architecture (IA) products that are configured in a prescribed way for optimal performance as a process automation system. This section provides a description of the architectures and system elements that you can use to assemble a PlantPAx system, and the system performance attributes that you should be able to achieve when following the recommendations of this manual.

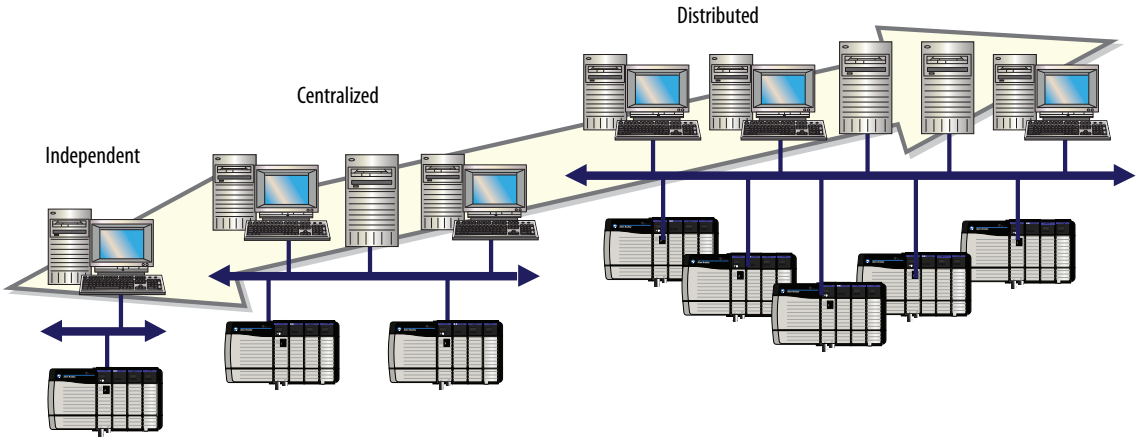
The following table describes what this chapter contains and where to find specific information.

Topic	Page
Architecture Classes	14
System Elements	15
Critical System Attributes	15
System Procurement Tools	16

Rockwell Automation characterizes a process automation system based on its size or architecture class. A 'characterized' (system tested) classification yields system performance data and recommended hardware and software configurations. The classes of PlantPAx architecture offer system scalability while organizing IA products consistent with process industry expectations.

The architecture classes shown in the illustration are described as the following:

- Independent system architecture for single unit control
- Centralized system architecture for area control
- Distributed system architecture for plant-wide operations.

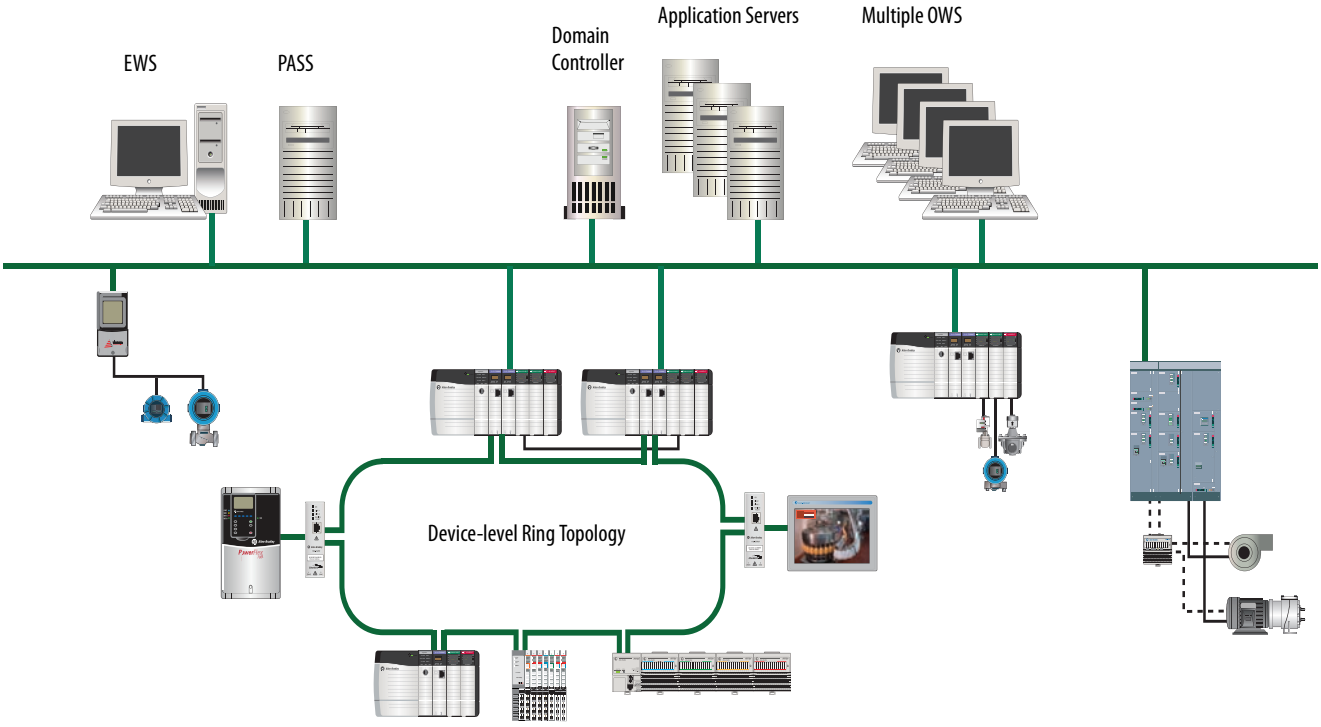


Architecture Classes

Architecture classes define system capabilities that can be scaled by modifying the same system elements.

Architecture	Description	System Elements
Independent	An independent class architecture uses a single computer to perform hosting, engineering, and operational functions.	• Single computer serves as the PASS, EWS, and OWS
Centralized	The centralized system is a multi-client configuration that supports the concept of automating a single production or process area. The system elements can provide main control room operation and enable you to mount operator workstations locally throughout the production facility. The centralized system expands the independent system by adding workstations and controllers.	• 1 dedicated PASS (see System Elements) • As many as 5 EWS for the development and maintenance of the system • As many as 8 OWS for the interactive graphical interface • Additional application servers for batch management, process information, or asset management if applicable • Multiple MWS, typically laptops
Distributed	The distributed system is a multi-server, multi-client configuration that supports automating a process with semi-independent areas. The distributed class architecture expands on the centralized class by adding application servers to interconnect multiple process areas into a system. A distributed system can have up to four control areas.	Each of the four control areas supports these elements. • 1 dedicated PASS. • Up to three additional AppServ-HMI to support additional processing areas and clients • As many as 5 EWS • As many as 8 OWS per PASS or AppServ-HMI • Additional application servers for batch management, process information, or asset management if applicable

The diagram shows an example of PlantPAx system architecture utilizing the EtherNet/IP network. This example could be a centralized or distributed architecture class.



System Elements

System elements are specific IA products grouped to provide process system functionality.

System Element	Independent Class	Centralized Class	Distributed Class
Process automation system server (PASS)	Single computer serves as PASS, EWS, and OWS in an independent workstation	One PASS required and includes: • FactoryTalk Directory server • HMI server • Data server	One PASS required and includes: • FactoryTalk Directory server • HMI server • Data server
Engineering workstation (EWS)	Included in independent workstation	• 1 EWS required • Can have as many as 5 EWS	• 1 EWS required • Can have as many as 5 EWS
Operator workstation (OWS)	Included in independent workstation	8 remote clients	8 remote clients for PASS 8 additional remote clients per AppServ-HMI
Process controller(1)	1…5 ControlLogix® controllers	1…6 ControlLogix controllers	1…6 ControlLogix controllers per PASS 1…6 ControlLogix controllers per AppServ-HMI
Application servers	None	One AppServ-Batch One AppServ-Information Management	One AppServ-Batch for each set of six controllers One AppServ-Information Management

(1) Controller count based on fully-loaded L63 controllers. Actual controller count allowed may vary based on controller selection and loading.

Critical System Attributes

A critical system attribute (CSA) is a visible performance indicator of a system-wide characteristic to define or identify if a system is working at a specified level. CSAs are pass/fail attributes.

Critical system attributes do the following:

- Determine system limits
- Establish system rules
- Establish system recommendations
- Measure system element and system infrastructure performance

The following critical system attributes were used to verify performance during process system characterization.

Table 2 - CSA Performance Indicators

Critical System Attribute	Performance
Display callup (paint time)	A noncached display is called up by the operator and ready for operator use within 2 seconds.
Display update	The display updates control information within 1 second.
Steady state alarm time	Steady state alarms occurring at 20 per second are timestamped within 1 second.
Alarm burst time	All alarms in a burst of 1000 alarms are timestamped within 3 seconds.
Recovery	A system element returns to full operation within 5 minutes of the restoration after a failure or loss.
Data logging	The system supports local (HMI) data logging of 200 points once a second.
Operator-initiated control	Operator-initiated actions are loaded into the controller and the feedback for the operator action is within 2 seconds.
Batch server: operator action time	An operator batch command has been acted on by the controller in 1 second.
Batch server: server action time	A server batch command has been acted on by the controller in 1 second.
Batch server: controller action time	Batch status events display on the operator workstation within 1 second.

System Procurement Tools

The following chapters of this manual contain recommendations and considerations for implementing your system. If you have not selected or procured your PlantPAx system architecture and components (see page 18), see the PlantPAx Selection Guide for more information, including use of the Integrated Architecture Builder (IAB) tool.

Rockwell Automation offers the IAB tool to help create a bill of material for an automation system. This graphical software tool helps you select hardware that includes controllers, I/O, networks, drives, cabling and wiring, motion control, and other devices.

IAB also includes a Process System Estimator (PSE) to size your process control hardware. By entering data of your system requirements, an optimal architecture can be defined to feed into the IAB tool.

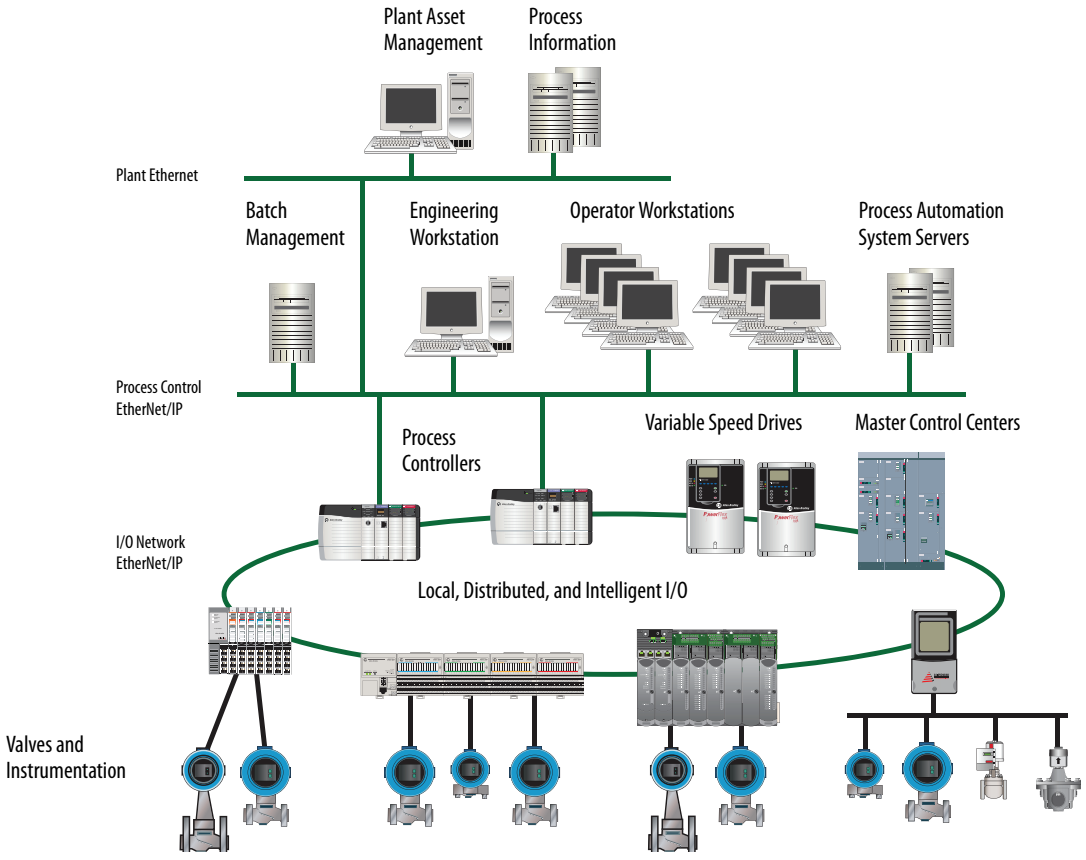
See http://www.rockwellautomation.com/en/e-tools/configuration.html .

System Element Recommendations

PlantPAx system elements refer to the individual servers, clients, and controllers that comprise a PlantPAx system. These building blocks are the foundation of your system architecture.

The following table describes what this chapter contains and where to find specific information.

Topic	Page
PlantPAx Software Components	18
Process Automation System Server (PASS)	18
Engineering Workstation (EWS)	20
Operator Workstation (OWS)	20
Process Controller	21
AppServ-HMI	30



PlantPAx Software Components

Integrated Architecture software components and versions that comprise the PlantPAx system release 2.0 include the following:

- RSLogix™ 5000 software, version 19.*x*
- FactoryTalk View software, version 6.00.00
- FactoryTalk® Batch software, version 11.00.00
- FactoryTalk® AssetCentre software, version 4.00.00
- FactoryTalk VantagePoint software, version 3.00.00
- FactoryTalk® Historian software, version 2.20.00

Additional tools and libraries are available that, when combined with Integrated Architecture software components, greatly enhance PlantPAx capabilities. For example, the PlantPAx Process Library is a predefined library of control code, faceplates, and display elements designed to allow a process user to quickly assemble large applications with proven strategies and expected results.

See Chapter 3 for more information.

Process Automation System Server (PASS)

The process automation system server (PASS) is a required system element that contains these Rockwell Automation Integrated Architecture software components.

Software Components	Description
FactoryTalk® Network Directory server(1)	Secures information from multiple Rockwell Automation software components across multiple computers and allows central administration throughout the PlantPAx system. In this way, application components, such as display and security settings, can be stored in their original environments and made available to the entire PlantPAx system without the need for duplication. See Set Up the FactoryTalk Directory on page 19 for more information.
FactoryTalk® Activation server(1)	FactoryTalk Activation is part of the FactoryTalk® Services Platform. It allows FactoryTalk-enabled products to be activated via files generated by Rockwell Automation over the internet. This server essentially manages the files required to license Rockwell Automation products on the PlantPAx system.
FactoryTalk View HMI server	The human-machine interface (HMI) servers are configured within your FactoryTalk View Site Edition (SE) application. It stores HMI project components, such as graphic displays, and serves these components to Operator Workstations (OWS) upon request. The HMI server also can manage tag databases and log historical data. Multiple HMI servers can exist on the PlantPAx system. See AppServ-HMI on page 30 for more information.
FactoryTalk View Data server	The Data server component provides access to information from the process controllers to the HMI server and OWS station. FactoryTalk® View supports two types of data servers: Rockwell Automation Device servers (RSLinx® Enterprise) and OPC Data servers. The Data server mentioned in PlantPAx documentation generally refers to the Rockwell Automation Device servers. Data servers are configured within your FactoryTalk View SE application. Multiple data servers can exist on the PlantPAx system. See AppServ-HMI on page 30 for more information.
FactoryTalk View Alarms and Events server	The Alarms and Events server is an optional component on the PASS that makes alarm information from controllers and servers available to all subscribing OWS stations. Alarms and Events servers are configured within your FactoryTalk View SE application. There are two types of Alarms and Events servers: device-based alarm and event servers (that is, configured as an option to the data server), and server-based alarm and event servers (configured as a separate component). The Alarms and Events server mentioned in PlantPAx documentation refers to the Alarms and Events server that is used for server-based alarms. You can have up to two Alarms and Events servers on the PlantPAx system. These may exist on the PASS or an AppServ-HMI. See Alarm Implementation Recommendations on page 41 for more information.
Optional	
FactoryTalk® Batch client software	If a Batch Application server is being used on the system, FactoryTalk Batch client components are required to support replication of batch-related objects on the displays to the OWS.

(1) In redundant PASS configurations, these components are included on the primary PASS only. See PASS Server Redundancy on page 20 for more information.

IMPORTANT If you are using FactoryTalk® Batch, the batch components should be installed before any other FactoryTalk components. See page 64 for details.

If a domain is used, add the PASS to the domain before installation. See page 45 for details.

Set Up the FactoryTalk Directory

Before starting a project, you must install FactoryTalk Directory services on the PASS. The FactoryTalk Directory server manages applications that may exist on multiple clients and servers on separate computers on the PlantPAx system.

IMPORTANT It is required to have a username and password with Administrator privileges to install FactoryTalk software and to specify a FactoryTalk Directory location. Use the same username and password for all FactoryTalk installations on the PlantPAx system.

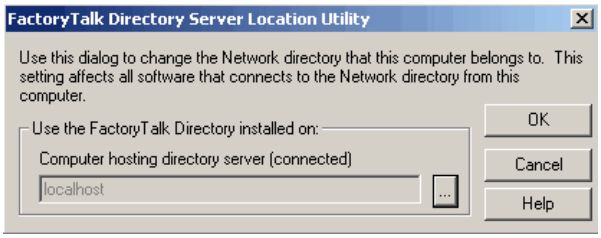
After Rockwell Automation software components are installed, you need to specify the FactoryTalk Directory location on all servers and workstations. Specify the location as follows:

- Localhost on the PASS server
- Name of the PASS server on each APPServ-HMI, OWS, EWS, and so forth

Do these configuration steps.

1. On each server and workstation hosting a PASS, Application Server, EWS, or OWS, choose Start/Programs/Rockwell Software/FactoryTalk Tools/ Specify FactoryTalk Directory Location.

   The FactoryTalk Directory Server Location Utility appears. .


FactoryTalk Directory Server Location Utility
Use this dialog to change the Network directory that this computer belongs to. This setting affects all software that connects to the Network directory from this computer.
Use the FactoryTalk Directory installed on:
Computer hosting directory server (connected)
localhost
OK
Cancel
Help

2. In the Computer hosting directory server (connected) box, do the following:
   a. Type localhost if you are configuring the PASS server.
   b. Click Browse and select the PASS server name if configuring an Application Server, EWS, or OWS.
   c. Click OK.

   See the FactoryTalk View SE Installation Guide, publication VIEWSE-IN003, for more information on FactoryTalk View installations.

PASS Server Redundancy

The following PASS Server software components can be made redundant:

- FactoryTalk View HMI Server
- FactoryTalk View Data Server
- FactoryTalk View Alarm and Event Server

All of these can be made redundant through the server properties dialog box within the FactoryTalk View application. When enabling redundancy in FactoryTalk® View Studio, select the option to 'Continue using the secondary server even when the primary server becomes available again' to avoid excessive switchovers and to be able to manage replication of application changes made before or after the switchover occurs.

The FactoryTalk Directory server does not require redundancy. The FactoryTalk Directory information is cached on each computer that is participating in a distributed application. If the FactoryTalk Directory server computer is disconnected from the network or fails, the OWS, EWS, and other application servers can continue to access everything within the application as long as the computer had previously accessed the FactoryTalk Directory server.

Engineering Workstation (EWS)

The engineering workstation (EWS) is the central location for monitoring and maintaining the system operation.

Software components that need to be installed include the following:

- RSLogix™ 5000 Professional Edition
- RSNetWorx™ for ControlNet™ depending on your architecture requirements
- FactoryTalk View Site Edition Studio and Client
- FactoryTalk Batch Client software

If a batch application server is used, the FactoryTalk Batch client and editor components are required to configure the FactoryTalk Batch system and setup the FactoryTalk objects on the displays.

Operator Workstation (OWS)

The operator workstation (OWS) provides a graphical interface for the operator; it's not meant to support development or maintenance activities. The OWS is a client of either a PASS server or AppServ-HMI.

Software components that need to be installed include the following:

- FactoryTalk View Site Edition (SE) client software

The OWS also may contain clients for non-core application servers, such as FactoryTalk Batch, FactoryTalk® Historian, or FactoryTalk® AssetCentre.

Process Controller

This section describes the components and sizing attributes for simplex, skid-based, and redundant controllers.

Simplex Controller

Simplex controller hardware components are the ControlLogix family of products in a non-redundant configuration.

Table 3 - Simplex Controller Hardware

Hardware	Product
Process controller(1)	ControlLogix 1756-L61, 1756-L62, or 1756-L63 controller ControlLogix 1756-L72, 1756-L73, or 1756-L74 controller
EtherNet/IP interface	• 1756-EN2TR/B, 1756-EN3TR, 1783-ETAP (supports device-level ring topology) • 1756-EN2T, 1756-ENBT, 1756-EWEB, 1756-EN2F, 1783-ETAP1F, 1783-ETAP2F. The fiber 1783-ETAP modules support device-level ring topology.
ControlNet interface	• 1756-CN2, 1756-CN2R • 1756-CNB, 1756-CNBR

(1) If environmental conditions warrant, you can use an extreme temperature controller, for example, the 1756-L74XT.

Table 4 - Simplex ControlLogix Controller Sizing

Attribute(1)	1756-L61	1756-L62	1756-L63(2)	1756-L72	1756-L73	1756-L74	1756-L75
User memory	2 MB	4 MB	8 MB	4 MB	8 MB	16 MB	32 MB
Total I/O recommended, max	375	750	1500	750	1500	2250	2250
Total tags, max	15,625	31,250	62,500	31,250	62,500	112,500	112,500
Recommended control strategies, max(3)	60	125	250	125	250	450	450
Total control strategies @ 250 ms, max	60	125	125	125	250	250	250
Total control strategies @ 500 ms, max	60	125	250	125	250	450	450
Tags/sec delivered to data server, max(4) (5)	10,000	10,000	10,000	20,000	20,000	20,000	20,000

(1) These values are maximum limits. You may not be able to achieve all of these in a single controller.

(2) For a PlantPAx system, we recommend that you use only the controller platforms characterized in this table. If 1756-L64 or 1756- L65 controllers are used, be aware that the additional management of the extended memory space may impact the CPU utilization of the controller when compared to a 1756-L63 controller (typically 10…15%).

(3) Representative control strategy (PID loop) includes 1 analog input, 1 analog output, 1 PIDE instruction, 8 logic/math instructions, and up to 8 configured alarms with PlantPAx process objects and native instructions.

(4) Assumes RSLinx® Enterprise software, version 5.30.00, at 10 K/sec per instance.

(5) We recommend that you configure alarming by using FactoryTalk Alarm and Events server-based alarms. See Alarm Implementation Recommendations on page 41.

Skid-based Controller

PlantPAx supports small-footprint controllers from the CompactLogix™ family for skid-based or small, local applications.

Table 5 - Skid-based Controller Hardware

Hardware	Product
Process controller	CompactLogix 1769-L23E, or 1769-L35E controller

Table 6 - Skid-based Controller Sizing

Attribute(1)	CompactLogix 1769-L23E	CompactLogix 1769-L35E
User memory	0.5 MB	1.5 MB
Total I/O recommended, max	80	250
Total tags, max	4000	12,800
Recommended control strategies, max(2)	10	30
Total control strategies @ 250 ms, max	10	30
Total control strategies @ 500 ms, max	10	30
Tags/sec delivered to data server, max(3)	3000	3000

(1) These values are maximum limits. You may not be able to achieve all of these in a single controller.

(2) Representative control strategy (PID loop) includes 1 analog input, 1 analog output, 1 PIDE instruction, 8 logic/math instructions, and up to 8 configured alarms with PlantPAx process objects and native instructions.

(3) Assumes RSLinx Enterprise software, version 5.30.00, at 10 K/sec per instance.

Redundant Controllers

ControlLogix controllers support enhanced redundancy on ControlNet and EtherNet/IP networks.

Table 7 - Redundant Controller Hardware

Hardware	Product
Process controller[1]	ControlLogix 1756-L63 controller ControlLogix 1756-L73, 1756-L74, or 1756-L75 controller Do not combine 1756-L6x and 1756-L7x controllers in a redundant chassis.
Redundancy module	• 1756-RM
Controller data and I/O memory	Each controller in the redundancy chassis has enough memory to store twice the amount of controller data and I/O memory. The increase of memory usage provides for a bumpless transfer during a switchover to make sure the secondary Logix controller has the same values in its output image as the primary Logix controller. This prevents a switchover to a secondary controller with a mixture of old and new data memory. See 'Understand ControlLogix Redundancy Memory Usage' in Knowledgebase Answer ID 28972 at http://rockwellautomation.custhelp.com for more information. You must have a Rockwell Automation support agreement.
Redundant EtherNet/IP network	A redundant Ethernet network is based on architecture topology and requires multiple Ethernet interfaces: 1756-EN2T, 1756-EN2TR/B, 1756-EN3TR
Redundant ControlNet network	A redundant ControlNet network requires a ControlNet interface that supports redundant media: 1756-CN2R or 1756-CN2RXT Identical ControlNet modules are placed in the same slot of both chassis of the redundant pair. ControlNet modules are identical in redundancy firmware revision and in series.

(1) If environmental conditions warrant, you can use an extreme temperature controller, for example, the 1756-L74XT.

Table 8 - Redundant ControlLogix Controller Sizing

Attribute[1]	1756-L63[2]	1756-L73	1756-L74	1756-L75
User memory	8 MB	8 MB	16 MB	32 MB
Total I/O recommended, max	750	750	1500	2250
Total tags, max	31,250	31,250	62,500	125,000
Recommended control strategies, max[3]	125	125	250	450
Total control strategies @ 250 ms, max	60	120	120	120
Total control strategies @ 500 ms, max	120	125	220	220
Tags/sec delivered to data server, max[4] [5]	10,000	20,000	20,000	20,000

(1) These values are maximum limits. You may not be able to achieve all of these in a single controller.

(2) For a PlantPAx system, we recommend that you use only the controller platforms characterized in this table. If 1756-L64 or 1756- L65 controllers are used, be aware that the additional management of the extended memory space may impact the CPU utilization of the controller when compared to a 1756-L63 controller (typically 10…15%).

(3) Representative control strategy (PID loop) includes 1 analog input, 1 analog output, 1 PIDE instruction, 8 logic/math instructions, and up to 8 configured alarms with PlantPAx process objects and native instructions.

(4) Assumes RSLinx Enterprise software, version 5.30.00, at 10 K/sec per instance.

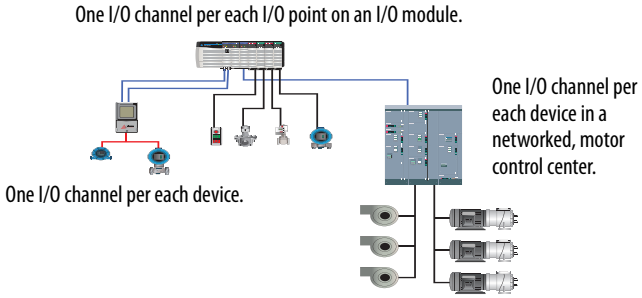
(5) We recommend that you configure alarming by using FactoryTalk Alarm and Events server-based alarms. See Alarm Implementation Recommendations on page 41.

Determining I/O Count

The I/O count for controller sizing is often determined directly from the application P&ID or plant design.

On existing systems where only classic I/O (for example, 4...20 mA, 24V DC dry contacts, and so forth) is used, the I/O count can be determined by the number of I/O channels available on the I/O cards.

When you have integrated smart devices, such as drives on transmitters on an EtherNet/IP network, any signal from the device used by your control strategy is considered an I/O point.


One I/O channel per each I/O point on an I/O module.
One I/O channel per each device.
One I/O channel per each device in a networked, motor control center.

For example, an I/O count for a system comprised with the following:

- Two 8-channel 4...20 mA input cards
- One 8-channel 4...20 mA output cards
- Two 16-channel 24V DC dry-contact input cards
- One MCC with six drives on EtherNet/IP
  - Each drive provides six signals to the control strategy: speed reference, actual speed, start, stop, running, and fault.
- Two Coriolis meters on PROFIBUS PA, with each meter providing three signals for flow, temperature, and density.

The I/O count example has the following calculation:

4...20 mA AI	2 x 8 = 16	
4...20 mA AO	1 x 8 = 8	
24V DC DI	2 x 16 = 32	
MCC	6 x 6 = 36	(6 AI, 6 AO, 12 DI, 12 DO)
Smart instruments	2 x 3 = 6	(6 AI)
Controller I/O count	98	

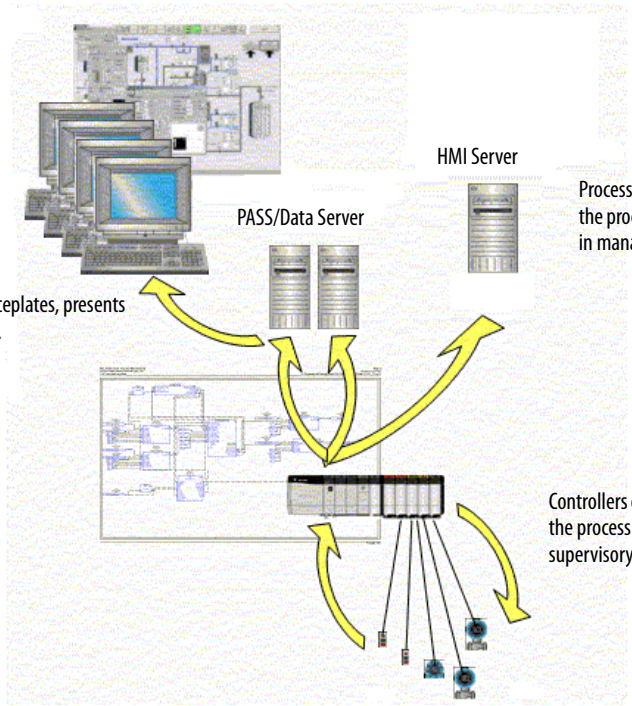
TIP When calculating I/O count for controller sizing, it is good practice to add spare capacity to allow for project changes or future enhancements. This could be accounted for by spare channels on existing systems or by adding spare as a percentage.

Sizing Control Strategies

A control strategy encompasses all of the application code required to implement a specific control function. This includes the I/O, controller code, display elements, and faceplates.

Using the control strategy model, we are able to estimate the following system parameters:

- HMI server tags on scan (alarm tags, display tags, data log tags, event detector tags, and derived tags)
- Controller memory usage
- Controller execution time
- Field device variables and health


HMI Server
Process Information servers collect the process and system data for use in managing the process.
PASS/Data Server
Operator interface, such as graphics and faceplates, presents system information to the human operator.
Controllers execute application code to control the process and communicate with the supervisory level.

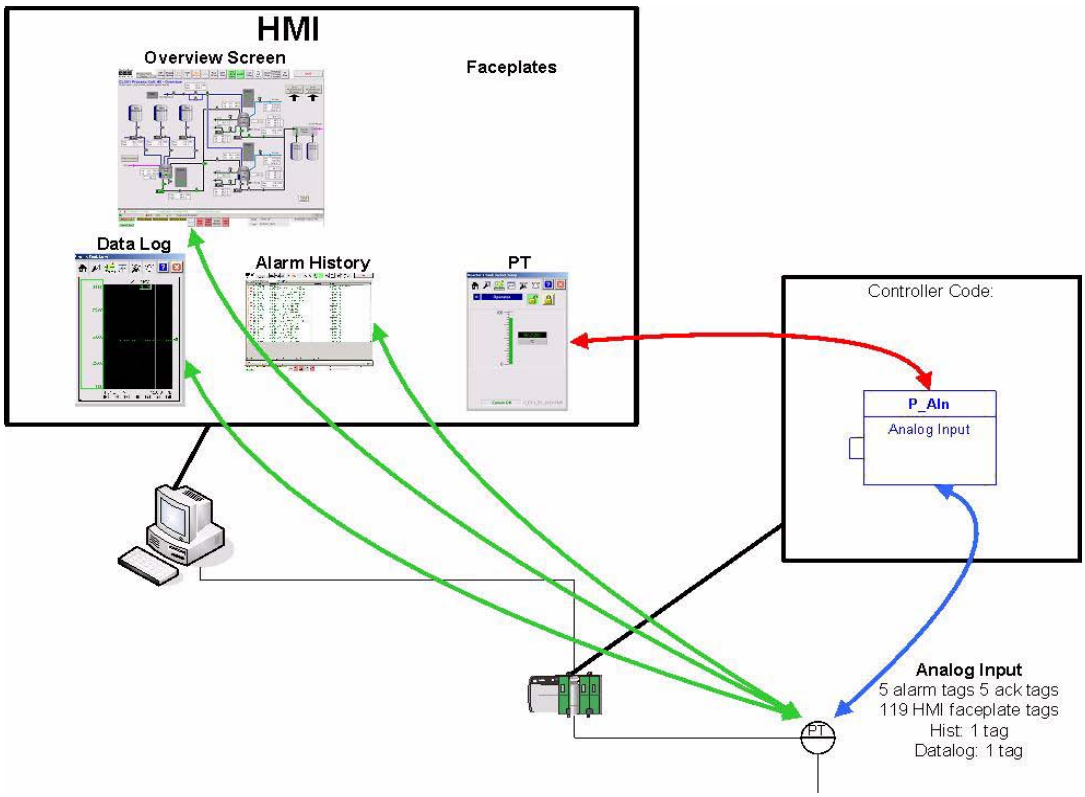
A system is considered working when it is performing at a specified level within established system boundaries. By estimating the size of control strategies, you have a better prediction of system performance.

The amount of resources consumed by the system elements to support a control strategy provides a 'footprint'. To size systems, these base control strategies have been established as system footprints:

- Simple digital
- Complex digital
- Simple analog (non PID)
- Simple analog (PID)
- Complex analog (cascaded PID)
- Digital indicator
- Analog indicator

The example diagram shows an example of the application code required for an analog indicator control strategy. Each physical device maps to a controller code element and to a display element and faceplate. System sizing takes into account other loading concerns related to the control strategy, such as data logging and alarming.

Figure 2 - Analog Indicator Example



The table shows details in Figure 2 for these base control strategies.

Table 9 - Base Control Strategy Estimated Loading

Control Strategy	Controller Execution Time (ms)	Controller Memory (KB)
Simple regulatory	0.68	8.7
Complex regulatory	1.39	11.9
Simple digital	0.33	5.1
Complex digital	1.08	13.5
Analog indicator	0.28	3.3
Digital indicator	0.11	2.5

The following occurs when using redundant controllers:

- Scan rate increases 2...3 times.
- Memory use increases 1.1...1.2 times.

Actual impact to control strategy loading when using redundant controllers can vary depending on the instructions used.

See the ControlLogix Enhanced Redundancy System User Manual, publication 1756-UM535, for more information.

Process Controller I/O Considerations

The requested packet interval (RPI) is a user-configured interval of time that determines when an I/O module's data is sent to a process controller. This interval defines the slowest rate at which a module multicasts its data. When the specified time frame elapses, the module multicasts data to the controller.

Setting the RPI faster (specifying a smaller number) than what your application needs wastes network resources, such as ControlNet schedule bandwidth, network processing time, and CPU processing time.

Table 10 - I/O Considerations

Attribute	Consideration
I/O configuration properties	• Specify an RPI that is two times faster than task execution: – 250 ms task requires a 125 ms RPI – 100 ms task requires a 50 ms RPI • Often RPI defined by the inherent properties of the signal being measured. For example temperature measurement changes slower. • Use compatible module for keying option on I/O cards configuration.

Table 10 - I/O Considerations

Attribute	Consideration
ControlNet network	• Set the network update time (NUT) equal to or less than the fastest RPI of the I/O modules and produced-consumed tags in the system. For example, if your fastest RPI is 10 ms, set the NUT to 5 ms for more flexibility in scheduling the network. • Set the RPI to a binary multiple of the NUT. For example, if the NUT is 10 ms, select an RPI such as 10, 20, 40, 80, 160 ms, and so forth. • All I/O should be unscheduled to be able to add ControlNet modules at runtime. (See I/O Module Runtime/Online Considerations.) Dedicate one ControlNet network to I/O communication only. • Unscheduled I/O requires a connection to each module, so the number of modules supported depends on the number of connections supported by the communication module. On the dedicated I/O network, make sure of the following: – No HMI traffic – No MSG traffic – No programming workstations – No peer-to-peer interlocking in a multi-processor system architecture
EtherNet/IP network	See Chapter 4 for infrastructure recommendations.

I/O Module Runtime/Online Considerations

With the PlantPAx system, you can add modules to the Controller Organizer in RSLogix 5000 software when the controller is in Run mode.

- You can add the 1756 I/O modules to the local chassis, remotely via the unscheduled portion of a ControlNet network, and remotely via an EtherNet/IP network.
- You can add the 1757-FFLDC linking device remotely to the unscheduled portion of a ControlNet network and the 1757-FFLD linking device remotely via an EtherNet/IP network.

Table 11 - Online Addition of Module and Connection Types

1756 Module Type and Communication Method	In Local Chassis		In Remote Chassis Via a ControlNet Network				In Remote Chassis Via an EtherNet/IP Network	
	Offline	Runtime	Offline		Runtime		Offline	Runtime
			Scheduled	Unscheduled	Scheduled	Unscheduled		
Analog - direct	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Generic third-party - direct	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
1756-DNB	Yes	No	Yes	No	No	No	Yes	Yes
1756-DHRIO	Yes	No	Yes	No	No	No	Yes	Yes
1756-CN*x* - no connection	Yes	Yes	Yes	Yes	No	Yes	N/A	N/A
1756-CN*x* - rack-optimized	N/A	N/A	Yes	N/A	N/A	N/A	N/A	N/A
1757-FFLD*x* linking device	N/A	N/A	N/A	N/A	N/A	N/A	Yes	Yes
1757-FFLDC*x* linking device	N/A	N/A	Yes	Yes	No	Yes	N/A	N/A
1788HP-EN2PA-R	N/A	N/A	N/A	N/A	N/A	N/A	Yes	Yes
1788HP-CN2PA-R	N/A	N/A	Yes	Yes	No	Yes	N/A	N/A
1756-EN*x* - no connection	Yes	Yes	N/A	N/A	N/A	N/A	Yes	Yes
1756-EN*x* - rack-optimized	N/A	N/A	N/A	N/A	N/A	N/A	Yes	Yes
Generic EtherNet/IP third-party - direct	N/A	N/A	N/A	N/A	N/A	N/A	Yes	Yes

When you design your network, review these considerations if you are going to add I/O modules at runtime.

Table 12 - Adding I/O Modules at Runtime

Design Issue	Consideration
I/O modules	Currently, only 1756 I/O modules can be added at runtime. Leave space in the local chassis, remote chassis on a ControlNet network, or remote chassis on an EtherNet/IP network for the I/O modules that you want to add.
Input transmission rate	Make sure each RPI works for the data you want to send and receive. Make sure the added I/O does not depend on change-of-state data.
Network topology	On a ControlNet network, install spare taps so you can add 1756 I/O modules at runtime without disrupting the network. Each tap must be terminated so as to not ground out the system. Check the ControlNet system requirements to determine how many spare taps your network can support. • In a ControlNet network with redundant cabling, you can break the trunk and add a new tap, but redundant cabling is lost during the module installation. • In a ControlNet ring, add a new drop off the rung or add new nodes off the coax and disrupt only part of the network. • You could remove a single existing node and add a repeater off of the drop. Then re-add the existing node and add any new nodes off of the new segment. On EtherNet/IP, reserve some connection points on the switch so that you can connect additional nodes or switches in the future.
Network configuration	On a ControlNet network, plan which communication can be scheduled or can be unscheduled. On an EtherNet/IP network, all communication is Immediate and occurs based on a module's RPI (also referred to as unscheduled). If you know that you will need a new chassis with digital modules in the future, configure the network and add it to the I/O configuration tree as rack-optimized. Then inhibit the communication adapter until you need the chassis.
Network performance	You can add I/O modules at runtime until you impact the capacity of the communication module. Make sure you have sufficient communication modules for the connections you plan to add.

See the Logix5000™ Controllers Design Considerations Reference Manual, publication 1756-RM094, for more information.

AppServ-HMI

Use these guidelines when gauging whether to implement an additional AppServ-HMI for your PlantPAx system.

- When you have more than one type of data server (such as RSLinx Enterprise or OPC data servers).
- When you want to balance the load (you are at > 40% CPU of your PASS or existing AppServ-HMI).
- For creating logical area; for example, you want to perform routine maintenance on a server for one area without affecting other areas.

The AppServ-HMI includes the following Rockwell Automation Integrated Architecture™ software components.

Software Component	Description
FactoryTalk View HMI server	The HMI server stores HMI project components, such as graphic displays, and serves these components to Operator Workstations upon request. The HMI server also can manage tag databases and log historical data. HMI servers are configured within your FactoryTalk View SE application.
FactoryTalk View Data server	The Data server component provides access to information from the process controllers to the HMI server and OWS station. FactoryTalk View supports two types of data servers: Rockwell Automation Device servers (RSLinx Enterprise) and OPC Data servers. The Data server mentioned in PlantPAx documentation generally refers to the Rockwell Automation Device servers. Data servers are configured within your FactoryTalk View SE application. Multiple data servers can exist on the PlantPAx system.
FactoryTalk View Alarms and Events server	The Alarms and Events server is an optional component on the PASS that makes alarm information from controllers and servers available to all subscribing OWS stations. Alarms and Events servers are configured within your FactoryTalk View SE application. There are two types of Alarms and Events servers: device-based alarm and event servers (that is, configured as an option to the data server), and server-based alarm and event servers (configured as a separate component). The Alarms and Events server mentioned in PlantPAx documentation refers to the Alarms and Events server that is used for server-based alarms. You can have up to two Alarms and Events servers on the PlantPAx system. These may exist on the PASS or an AppServ-HMI.
Optional	
FactoryTalk® Batch client software	If a Batch Application server is being used on the system, FactoryTalk Batch client components are required to support replication of batch-related objects on the displays to the OWS.

AppServ- HMI Redundancy

All the Application Server-HMI software components can be made redundant through the server properties dialog box with the FactoryTalk View application. When enabling redundancy in FactoryTalk® View Studio, select the option to 'Continue using the secondary server when the primary server becomes available again' to avoid excessive switchovers and to be able to manage replication of application changes made before or after the switchover occurs.

Follow these guidelines for redundant HMI servers.

- Avoid implementing HMI server redundancy until system testing or commissioning
- Initially, HMI server files should be copied from the primary to the secondary server. The Replication button can be used after initial copy.
- Alarm states are synchronized between HMI servers during runtime automatically.

System Application Recommendations

After initial installation of the system elements, there are system application recommendations to follow when creating application specific code. These recommendations help to make sure of optimal performance of the PlantPAx system.

The engineering workstation (EWS) supports system configuration, application development, and maintenance functions. This is the central location for monitoring and maintaining the system's operation.

The following table describes what this chapter contains and where to find specific information.

Topic	Page
Controller Recommendations	31
FactoryTalk View Recommendations	38
PlantPAx Library of Process Objects	40
Alarm Implementation Recommendations	41
Application Development Resources	43

Controller Recommendations

This section contains integral information for maximizing your controller and network resources. We strongly recommend that you review these topics for system application efficiency.

Process Controller Configuration

Using RSLogix 5000 software, configure your controllers and tasks by using the following recommendations.

Table 13 - Controller and Task Recommendations

Attribute	Recommendation
Tasks	A task provides scheduling and priority information for a set of one or more programs. Place your logic in periodic tasks. Create multiple periodic tasks to align with the appropriate scan rate based on the logic it contains. For example: • Fast (100…250 ms) for discrete control, such as motors and pumps • Medium (250 …500 ms) for flow and pressure loops or analog inputs • Slow (1000…2000 ms) for temperature, phases, batch sequencing Reduce the number of tasks created to improve controller performance. Do not use a continuous task. See Using Periodic Tasks on page 32.

Table 13 - Controller and Task Recommendations

Attribute	Recommendation
Task Properties	• To limit the amount of task switching, we recommend that priority be assigned based on scan rate, with faster tasks getting higher priority (configured by entering a lower number). Do not use the same priority for multiple tasks. • Set the watchdog to at least three times the task period. This specifies how long a task can run before triggering a major fault. • Inhibit or delete unused tasks. • To allow for communication load, it's recommended that the total execution time of all tasks is less than half of your fastest task rate. For example, if your fastest periodic task runs at 500 ms, the total execution time of all tasks should be < 250 ms. • CPU utilization varies based on communication status. When you are online, you can monitor the execution of your tasks from the Monitor tab of the Task Properties window. (1) • An overlap is a condition where a task (periodic or event) is triggered while the task is still executing the previous scan. You should also check that you are not experiencing task overlap by verifying the task overlap count is 0.
Controller Properties -Advanced	The system overhead time slice does not need to be set when a continuous task is not configured.
Controller Properties - Memory	• It's recommended to keep 50% of available data and logic memory available for communication. • The amount of data and logic memory the controller needs varies depending on the state of communication based on the number and type of tags that are accessed by applications, such as the HMI and Historian. Therefore, it's recommended to leave enough data and logic memory capacity to handle the communication. • When you are offline, you can estimate how much controller memory your project requires by using the Memory tab of the Controller Properties dialog box. When you are online, this tab displays actual memory usage of the controller (including memory used for communication). • Online, you can also view the maximum used memory as communication occurs from this tab.

(1) See Process Controller Utilization on page 36 for more information.

See Table 25 on page 69 for more information on controller memory.

Using Periodic Tasks

For PlantPAx system recommendations and sizing tools to work properly, the continuous task that is created by default in the RSLogix5000 software should be deleted or changed to a periodic task. If left as the default, the continuous task runs in the background of the controller as the lowest priority task. Any controller CPU time not allocated to other operations or tasks is used to execute the continuous task.

When the continuous task completes, it restarts automatically. System overhead time defines the amount of time the controller has available for communication and interrupts the continuous task for communicating to HMI devices, processing MSG instructions, and alarm instruction processing.

Continuous task is very good for high-speed discrete applications where the main goal is to execute code as fast as possible. We recommend not using the continuous task on the PlantPAx system for the following reasons:

- Time-based operations, such as a PID algorithm, do not function accurately when run in a continuous task.
- Removal of the continuous task improves predictability of the controller free-time available for communication to the system.
- Removal of the continuous task allows for a more accurate view of the controller loading at run time. With continuous task, controller loading is always 100%.
- Removal of the continuous task reduces the amount of task switching that improves overall application and system performance.

Controller Project Considerations

Configure the tasks in the process controller by using the following recommendations.

Table 14 - Process Controller Recommendations

Attribute	Recommendation
Tags	See Controller Tag Optimization.
Add-On Instructions	See Using Add-On Instructions on page 35.
Produced and consumed tags	A single produced and consumed tag can contain multiple combinations of data. For example, up to 120 REALs or 100 REALs and 640 BOOLs. Group produced and consumed tags into a user-defined structure to reduce the number of connections to the controller. Use the same data type for the produced and consumed tags in each controller that uses that data. Make sure the number of consumers configured for a produced tag is the actual number of controllers consuming it to reduce the number of connections to the controller. On produced tags, the maximum consumers configured counts against your total connection count so make it the actual number of connections or set it at the expected number to be in the future. Always use a handshake when transferring data between controllers through health data or manually configured diagnostics.
Messaging	There is a maximum of 32 cached message connections from message instructions and block-transfers combined. Cache messages only when the message needs to be maintained all the time. If a message instruction is infrequent then make sure cached connection is unchecked. Always use message reads, never do message writes. When messaging between controllers, use DINTs where possible. Message instructions consume a connection when it is a CIP data table read, write, or generic (if selected).

Controller Tag Optimization

When configuring displays, we recommend that you use direct tag referencing to access data from the controller directly without creating an HMI tag. This requires less configuration steps and is easier to maintain.

Use DINT and REAL data types whenever possible. Mathematical routines in the controller consume less memory when DINT and REAL data types are used.

A user-defined data type (UDT) lets you organize data to match your machine or process. Additional advantages of a UDT include the following:

- One tag contains all the data related to a specific system activity. This keeps related data together and easier to locate, regardless of its data type.
- Each individual piece of data (member) gets a descriptive name. This automatically creates an initial level of documentation for your logic.
- You can use the data type to create multiple tags with the same data layout.

For example, you can use a UDT to store all the parameters for a tank, including temperatures, pressures, valve positions, and preset values. Create a tag for each of your tanks based on that data type.

You can create a UDT when online or offline. However, you can only modify an existing UDT definition when offline.

General Recommendations

- Define tags in arrays and a UDT whenever possible. Tag data that is packed into an array is sent more efficiently to the HMI than if you were using scattered tag data.
- When defining a UDT, group BOOL tags together whenever possible. Inside the controller memory, BOOL tags must align on 8-bit boundaries. But, if they are placed adjacent to each other they can share the same byte and use less memory and communication bandwidth.
- BOOL data types that are not members of an array or structure use 4-bytes of controller memory. When communicating multiple BOOL tags between controllers or to displays, use a UDT or array to consolidate multiple BOOL tags into a single word.
- Define a tag naming convention that minimizes the length of the tag names. Long tag names can decrease the bandwidth available for communicating data.

See the Logix5000 Controllers I/O and Tag Data Programming Manual, publication 1756-PM004, for more information.

Using Add-On Instructions

Add-On Instructions are reusable codes that contain encapsulated logic that can streamline implementing your system. This lets you create your own instruction set for programming logic as a supplement to the instruction set provided natively in the ControlLogix firmware. An Add-On Instruction is defined once in each controller project, and can be instantiated multiple times in your application code as needed.

In RSLogix5000, you can view the routines within an Add-On Instruction instance online, animated with just that instance's value as if it were an individually defined routine. Add-On Instructions also can be source protected, which means users without the source key cannot edit the Add-On Instruction definition. To protect intellectual property, routines and local tags can also be hidden on protected Add-On Instructions, if desired.

The use of Add-On Instructions can save time by creating sets of commonly used instructions. They can be shared between projects to create a common library of instructions to accelerate engineering from project to project. Add-On Instructions also can be signed with a specific data and time, so that revisions of Add-On Instructions can be managed between projects.

Add-On Instructions can be used to create device-level instructions, like a valve controller or standard calculation, where each instance is configured but the source definition is unlikely to change. Like a native instruction, the definition of an Add-On Instruction cannot be modified online. Therefore, it's important that you fully test all configuration options before implementing an Add-On Instruction on your production system.

The PlantPAx Library of Process Objects uses Add-On Instructions. See page 40 for more information.

Process Controller Utilization

Free Process controller CPU time is required to handle communications, abnormal conditions, and other transient loads. Therefore, it's important to consider CPU utilization when implementing the application code.

When defining the application code, make sure the CPU utilization of the process controller can accommodate these values:

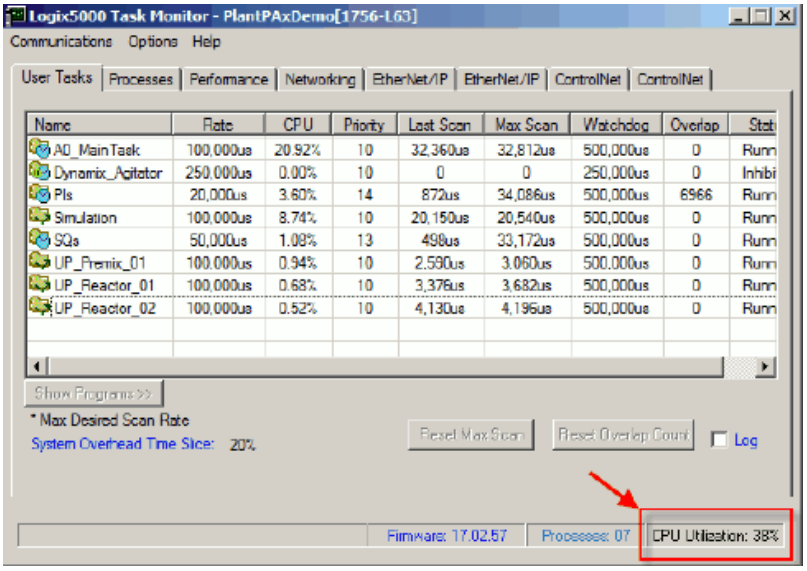
- In the development environment, CPU utilization should be less than 50% to allow for the additional CPU load that will be experienced in the production environment.
- During the operation of the system, the CPU utilization should be monitored, especially after a change to the application code, and should never exceed 75%.
- During the design of the application code, it is important to account for software components, such as FactoryTalk View or Historian, that are actively collecting data from the controller, to make sure CPU utilization is less than 75% to allow for communication with the supervisory system elements (EWS, OWS, Information server).

There are two options for reviewing controller loading:

- Task Monitor - Available from RSLogix 5000 software on the EWS.
- L_CPU Add-On Instruction - Preferred method of monitoring, viewable from HMI screens and available from the Knowledgebase Answer ID 62682 at http:/rockwellautomation.custhelp.com.

Task Monitor

If your process controller contains periodic tasks only (see page 32), use the RSLogix 5000 Task Monitor tool.


Logix5000 Task Monitor - PlantPAxDemo[1756-L63]
Communications Options Help
User Tasks Processes Performance Networking EtherNet/IP EtherNet/IP ControlNet ControlNet
Name Rate CPU Priority Last Scan Max Scan Watchdog Overlap Stat
AD_MainTask 100,000us 20.92% 10 32,360us 32,812us 500,000us 0 Runn
Dynamix_Agitator 250,000us 0.00% 10 0 0 250,000us 0 Inhibi
PIs 20,000us 3.60% 14 872us 34,086us 500,000us 6966 Runn
Simulation 100,000us 8.74% 10 20,150us 20,540us 500,000us 0 Runn
SQs 50,000us 1.08% 13 498us 33,172us 500,000us 0 Runn
UP_Premix_01 100,000us 0.94% 10 2,590us 3,060us 500,000us 0 Runn
UP_Reactor_01 100,000us 0.68% 10 3,376us 3,682us 500,000us 0 Runn
UP_Reactor_02 100,000us 0.52% 10 4,130us 4,196us 500,000us 0 Runn
Show Programs >>
* Max Desired Scan Rate
System Overhead Time Slice: 20%
Reset Max Scan
Reset Overlap Count
Log
Firmware: 17.02.57
Processes: 07
CPU Utilization: 38%

Processor Utilization (L_CPU)

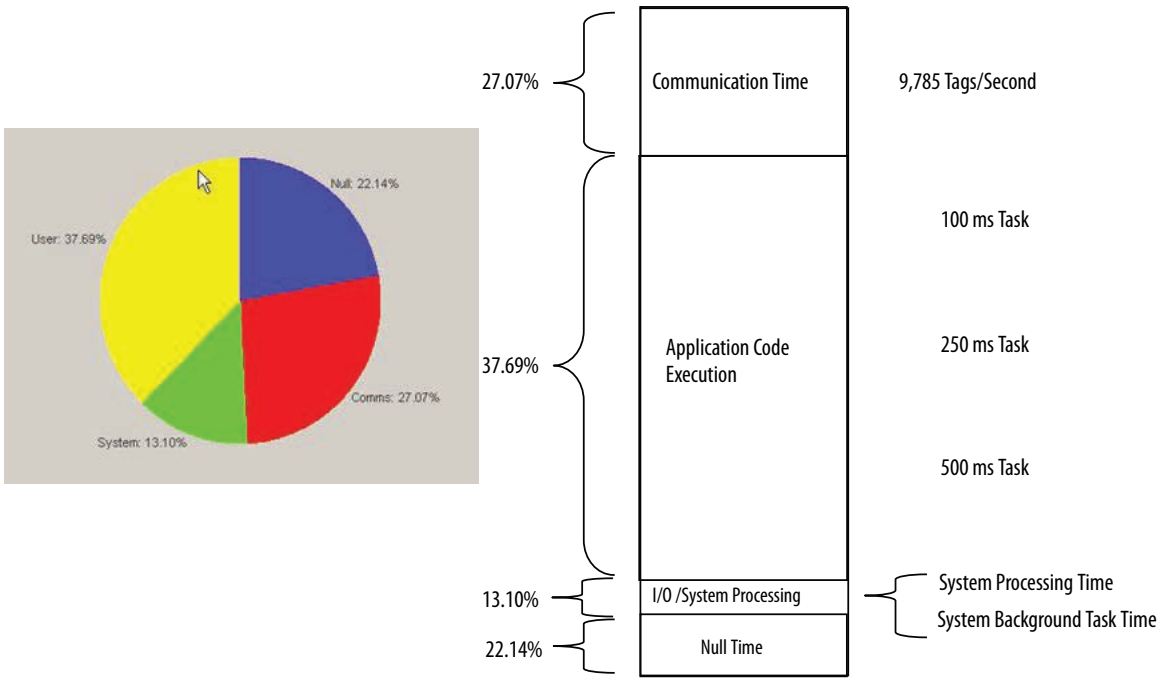
The Logix Controller CPU Utilization (L_CPU) Add-On Instruction monitors the Logix controller executing it and is used in place or addition to the Task Monitor to provide more system-specific controller loading information.

Information includes controller CPU utilization, communication usage, memory usage, and task scan times. This data provides information for diagnosing communication, controlling responsiveness issues, or in tuning the performance of control tasks for optimum controller performance.

The diagram in Figure 3 shows a properly loaded controller for the following:

- Allocation code execution, I/O processing is less than 70% CPU
- Expected communication is less than 30% CPU

Figure 3 - CPU Utilization



See the Process Add-On Instructions: Processor Utilization (L_CPU) in the Knowledgebase Answer ID 62682 at http:/rockwellautomation.custhelp.com.

FactoryTalk View Recommendations

For implementing FactoryTalk View SE software for a process system operator interface, follow these guidelines:

- Run FactoryTalk View Studio software on the EWS during runtime. Do not run FactoryTalk View Studio software on the server (PASS or AppServ-HMI) during runtime operation.
- Set the FactoryTalk View SE servers to start automatically on start up on the AppServ-HMI and PASS. Let the servers fully start up before starting the client computers.
- Do not run remote desktop clients on the AppServ-HMI or PASS.
- Do not use the remote desktop for system development.
- Any 1 Area contains only 1 server of any type (HMI or Data). This will prevent the failure of one data server from affecting any others that are in the same area. This will also prevent potential performance problems.
- Minimize the number of areas accessed on one display.
- Use global objects to display the status of a control module or device when the information to be displayed is stored in a tag structure within Logix (for example, UDT or AOI) and there are many identical instances. A global object is a display element that is created once and can be referenced multiple times on multiple displays in an application. When changes are made to the original (base) object, the instantiated copies (reference objects) are automatically updated. Use of global objects, in conjunction with tag structures in ControlLogix, can help ensure consistency and save engineering time.
- When using global objects, observe the following recommendations to ensure optimal display call-up performance:
  - Base global objects are stored in FactoryTalk View in global object displays (.ggfx files). If you have a large number of base global objects defined, do not put them all in a single global object display. Try to organize your global object displays logically, trying to keep an average of 30 base global objects per global object display while minimizing the number of different global object displays referenced by a single standard display.
  - Limit the number of global object instances on a single display to 40 or less.
  - As global objects may be instantiated multiple times, the performance impact of their design is amplified by their number of instances. Therefore, design global objects carefully to reduce the number of objects, expressions and animations used within the base object.
- Limit the number of dynamic references on a display to 1,000 references (HMI or direct reference tags). Be aware that each global object instance may represent multiple references, and global objects are allowed to reference other global objects. This improves display call up performance.
- Use derived tags for complex expressions or alarm functions that are repeatedly used within graphic displays (for example, alarm expressions). This reduces HMI server load.

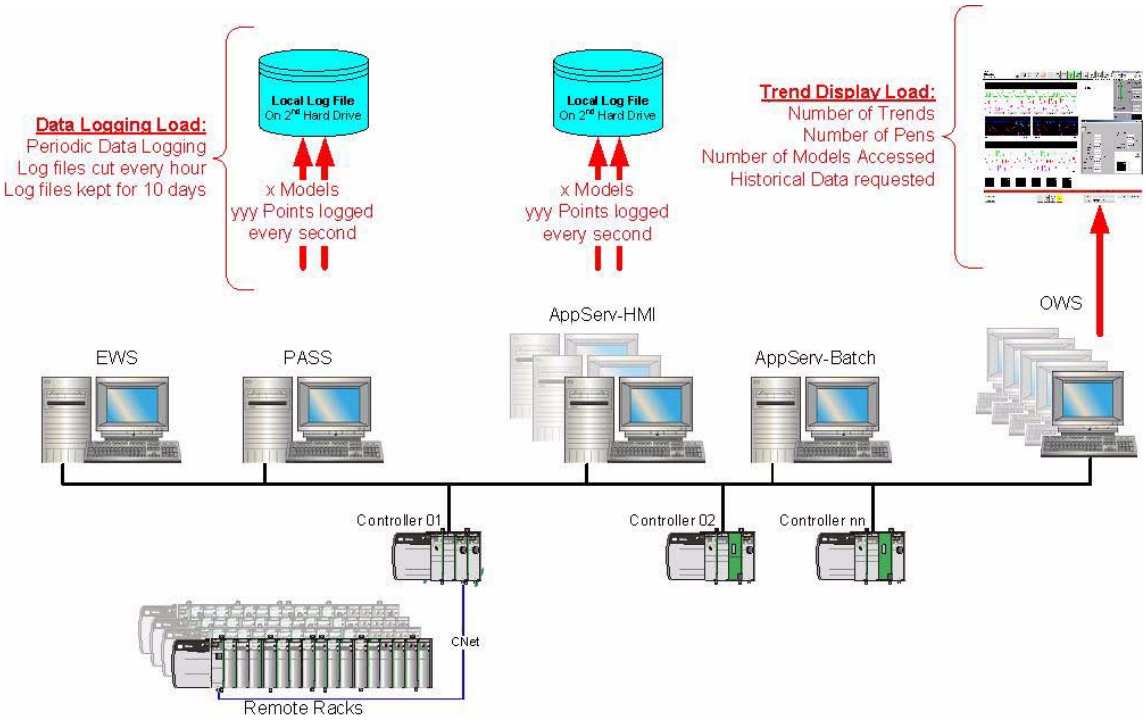
- Do not create derived tags that depend on the results of other derived tags. Derived tag processing is not sequential.
- Avoid use of VBA when possible. VBA runs as a single-threaded process, so if VBA is performing badly, the entire HMI can perform badly.

Data Log Recommendations

Data logging uses the FactoryTalk View SE application data log capability, and should be used for only short-term data retention (typically less than a 24-hour period). Data is stored on the PASS or AppServ-HMI of operator-defined process variables to aid in controlling the process. Data logging is for storing a minimal number of data (for example, no more than 50 data log points per controller). For long-term data storage or to collect a large number of data points, use the FactoryTalk Historian software.

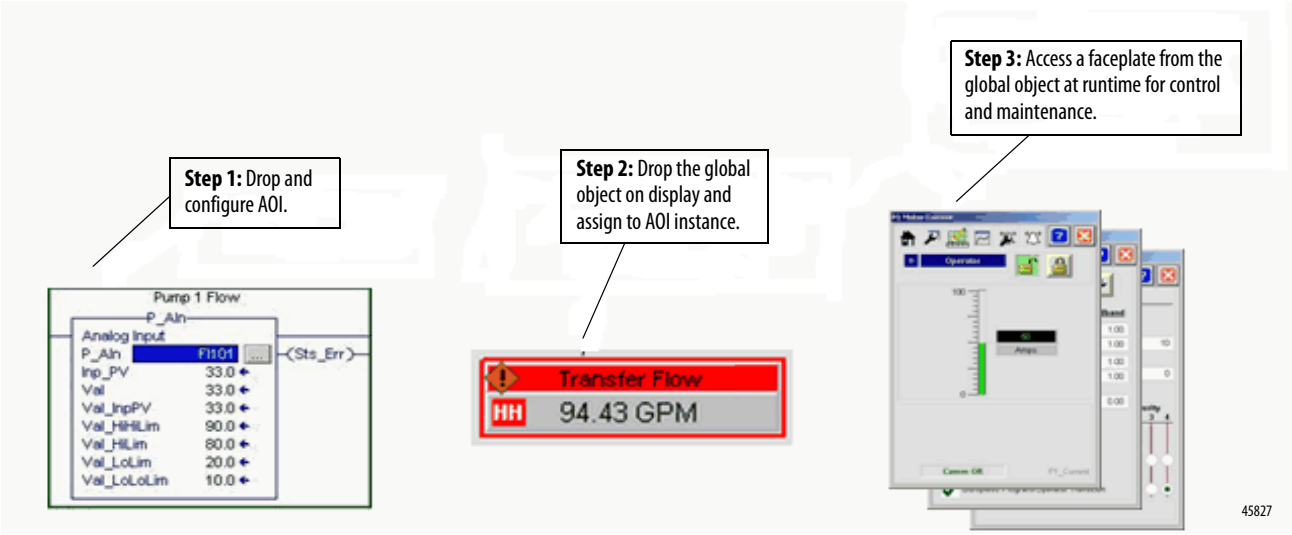
Configure data logging to the following:

- Log to a separate drive from the system drive (for example, file set, absolute path is D:\Logfiles)
- Delete oldest file after 10 days to conserve disk space, if necessary
- Set logging to periodic for a consistent system load
- Set to logging to on change for infrequently changing data
- Set interval to 1 second or greater
- Defragment data drive (usually drive D) daily with a third-party package for better retrieval performance.



PlantPAx Library of Process Objects

The PlantPAx Library of Process Objects is a predefined library of controller code (Add-On Instructions), display elements (global objects), and faceplates that let you quickly assemble large applications with proven strategies, rich functionality, and known performance. This library is available from the Knowledgebase Answer ID 62682 at http://rockwellautomation.custhelp.com, complete with instruction documentation.



The PlantPAx Library of Process Objects is supported through Rockwell Automation Technical Support as long as the Add-On Instructions have not been modified from the original deployment.

You can use library objects other than the PlantPAx collection. For example, you can choose to develop your own library, or use the PlantPAx elements and faceplates as guides. Using a library of consistent elements will improve the maintainability and efficiency of your PlantPAx system.

Alarm Implementation Recommendations

PlantPAx offers two options for configuring alarms: HMI classic alarming and FactoryTalk Alarm and Events.

Table 15 - Alarm Options

Alarm Options	Description	
HMI Classic Alarming	Using FactoryTalk View, you would configure alarms as a property of a HMI tag in the HMI server.	
	Advantages • Only architecture supported for FactoryTalk View ME (PanelView Plus) • Support for a high number of alarms (40,000 per HMI server of which 10,000 can be analog tags)	**Disadvantages** • Limited visualization objects • Limited alarm logging functionality • Logs alarm in local time (as configured in the HMI server)
FactoryTalk® Alarms and Events	Alarms can be configured in the controller or in a FactoryTalk View server. Device-based alarms (ALMA, ALMD) are subscribed to by the RSLinx Enterprise server when the option is enabled. Server-based alarms (digital, level, or deviation) are configured in a tag Alarm and Event server.	
	Advantages • Includes complete set of visualization components (Alarm summary, Alarm banner, Alarm Status Explorer, and so forth) • Native ability to log alarm history to SQL database • Logs alarm in UTC time	**Disadvantages** • No support for PanelView™ Plus platform (FactoryTalk View ME) • Lower number of supported alarms per system (20,000) and alarms and attached clients per system (20 OWS)

FactoryTalk Alarms and Events (FTAE) supports device-based alarms (ALMA and ALMD instructions in the controller) and server-based alarms (level, discrete, or deviation alarms). FTAE device-based and server-based alarms can co-exist in a single application.

For your PlantPAx system, we recommend that you use FTAE server-based alarms. Use device-based alarms for only the most critical or time-critical alarms.

HMI Classic Alarm Recommendations

- Only use HMI Classic Alarms if your application doesn't support the use of FactoryTalk Alarms and Events.
- Use alarm handshaking only for critical alarms to reduce the number of tags that must be held on scan in large applications.
- When making changes to the HMI tag database related to alarming, run the AlarmAcceptEdits command to make effective all alarm changes made since the last AlarmOn command. When using redundant HMI servers, AlarmAcceptEdits may cause the alarm synchronization between the primary and secondary server to stop because the configuration in the primary and secondary servers no longer match. To address this, after changes are made, replicate them to the secondary HMI server. Monitor the status of the secondary server to make sure it returns to Standby status.
- The number of HMI classic alarms per application should be limited to 40,000 total, of which no more than 10,000 can be analog tags.

General FactoryTalk Alarm Recommendations

- Use an alarm class to group alarms based on their function. For example, groupings that make it easier for operators to identify alarms related to bad I/O, controller deviation, device failures, or valves that fail to open or close.
- Use a tag naming convention that lets you group alarms by location to enable rolled up indicators by using alarm expressions in FactoryTalk View SE to retrieve alarm counts by name.
- The number of FactoryTalk alarms per application should be limited to 20,000 total.

FactoryTalk Server-based Alarm Recommendations

- The Tag Alarm and Event server and the Data server, which collects the information for the Tag Alarm and Event server, must both be hosted on the same server.
- An application is limited to two Tag Alarm and Event servers per application.
- For large applications, consider separating the data server used for alarms and events from the data server used for display data. You can do this by creating a separate AppServ-HMI that contains only the alarm and events server and its associated data server.
- Whenever possible, use Digital Alarms to perform the alarm detection in the controller to generate a Boolean indication of the alarm condition.
- Use the import and export features in FactoryTalk View SE when you need to configure a large number of alarms.

FactoryTalk Device-based Alarm Recommendations

- An application is limited to two RSLinx Enterprise servers with FactoryTalk Alarms and Events (FTAE) enabled.
- For large applications, consider separating the data server used for device-based alarms from the data server used for display data. You can do this by creating a separate AppServ-HMI that contains only the RSLinx Enterprise server with FTAE enabled.
- We recommend that you use ALMA and ALMD instructions for only the most critical or time critical alarms. There are no hard-coded limitations, but when ALMA and ALMD are used, we recommend limiting the number of instructions to 250 per redundant controller, 1000 per L6*x* simplex controller, or 2000 per L7*x* simplex controller.
- Be aware that controller scan time and memory usage is variable with the use of FTAE instructions depending on the states of the controller. Large alarm bursts can have a significant impact on controller CPU utilization. For example:
  - Controller memory used for buffering by each subscriber (RSLinx Enterprise) = 100 KB

– Example execution times:

ALMD in a 1756-L63 controller with no alarm state changes: 8 µs

ALMD in a 1756-L63 controller with alarm state changes: 35 µs

In redundant controller configurations, crossloading of redundancy can add up to 70 µs per ALMD instruction.

See the Logix5000 Controllers Execution Time and Memory Use Reference Manual, publication 1756-RM087, for more information.

Using the PlantPAx Library of Process Objects for Alarms

The PlantPAx Library uses a dedicated Add-On Instruction, titled P_ALARM, for each configurable alarm in the library elements. Documentation is provided with the Process Library to describe how to connect the Add-On Instruction instances with the HMI server for Classic Alarming or with Tag Alarm and Event Server for FactoryTalk Alarming.

We do not recommend the use of Classic Alarming and FactoryTalk Alarm and Events together in a single application. However, we do recommend the use of HMI Classic Alarming for your FactoryTalk® View ME applications and FactoryTalk Alarm and Events Alarming for your FactoryTalk View SE application, which can both talk to the same controller.

Application Development Resources

The following resources are available for use to assist with developing your application.

Topics and Tools	Description	Where To Find Information
PlantPAx Library	Diagnostic objects and enhanced process instructions to accelerate system engineering. See page 40 for details.	See the Knowledgebase Answer ID 62682 at http://rockwellautomation.custhelp.com.
FactoryTalk Diagnostic sample displays	Sample graphics to display RSLinx Enterprise sample counters.	See the Knowledgebase Answer ID 30148 at http://rockwellautomation.custhelp.com.
Server status displays	Sample code is provided to determine a server's current status and state by using VBA and displaying the status on the HMI screen.	See the Knowledgebase Answer ID 44624 at http://rockwellautomation.custhelp.com.
PlantPAx Preferred Integration tools	Add-On Instructions and pre-defined faceplates for Endress+Hauser field devices.	See the Knowledgebase Answer ID 60185 at http://rockwellautomation.custhelp.com.
Rockwell Automation Integrated Architecture tools	These tools can assist you in understanding, planning, and configuring an Integrated Architecture System.	http://www.rockwellautomation.com/solutions/integratedarchitecture/resources.html
Rockwell Automation sample code	Sample code and tools for configuring and programming Rockwell Automation products, including Rockwell specific faceplates.	http://samplecode.rockwellautomation.com/idc/groups/public/documents/webassets/sc_home_page.hcst
FactoryTalk® Batch implementation tools	Batch tools for collecting, organizing, reporting, and visualizing FactoryTalk View data.	See the following Knowledgebase Answer IDs at http://rockwellautomation.custhelp.com: • 62367 • 62372 • 67642

Notes:

Infrastructure Recommendations

The PlantPAx system infrastructure is built on an IT infrastructure based on commercial off-the-shelf technologies, such as Microsoft Windows, and open network technologies to allow for seamless integration between system elements and to higher-level business systems.

This chapter outlines recommendations for setting up the infrastructure components to achieve optimal performance of the PlantPAx system.

Topic	Page
Operating System Recommendations	45
Network Recommendations	51

Operating System Recommendations

The following recommendations apply regardless of the size or complexity of the system operation.

Domains and Workgroups

We recommend that PlantPAx servers and workstations be members of a Windows domain. However, workgroups are supported for systems with 10 or fewer workstations and servers.

Configuration	Details
Workgroup - decentralized administration (10 or fewer computers)	Workgroup advantages: • No domain controller (Windows Server OS) to purchase or maintain. • Recommended only for small PlantPAx applications where user accounts do not change often Workgroup rules: • All workstation and server system elements in a single PlantPAx system must be members of the same workgroup • All users participating in the workgroup must be members of the Administrators group • Create the same set of user accounts and passwords on every computer in a FactoryTalk View application
Domain - centralized administration	Domain advantages: • One place to manage Users, Groups, and Security settings • Recommended for larger PlantPAx applications, or environments with changing user accounts Domain rules: • All workstation and server system elements in a single PlantPAx system must be members of the same domain • PlantPAx server system elements should not be used as domain controllers. • Required for systems with more than 10 computers • The domain controller should be its own independent computer with no other application software.

Domain Recommendations

We recommend that all PlantPAx system servers and workstations be a member of a domain. Follow these additional recommendations:

- Windows Active Directory (AD) domains include the concept of a 'forest', which can consist of a single 'domain tree' or multiple domain trees.

  TIP A domain tree can consist of a single (parent) domain or multiple (child) domains. A single forest, single tree, single domain configuration is recommended. In a Windows 2008 Active Directory, both domains and forests have individual functional levels.

- We recommend configuring at least two domain controllers in the domain. These domain controllers will replicate automatically to provide high availability and an online configuration backup.
- Add the PASS as a member of the domain before developing your FactoryTalk View application.
- The domain servers also must be configured to include Domain Name Service (DNS), which lets you identify devices by name rather than IP addresses.
- Configure time synchronization throughout a domain.
- New and existing active directory domains should have operations verified by using Microsoft's Domain Controller Diagnostics (Dcdiag.exe) utility. This utility is included with the Windows support tools on the operating system CD and can also be downloaded from Microsoft.

IMPORTANT Do **not** install the Windows domain controller on the PlantPAx PASS server or application servers.

Windows Workgroup Recommendations

PlantPAx can use a Windows workgroup network environment for systems using 10 or fewer computers. However, if you are using a Windows XP operating system you must turn off simple file sharing and fast user switching on each PlantPAx server and workstation in the workgroup.

Do these steps to turn off simple file sharing in Windows XP.

1. On the desktop or in Windows Explorer, right-click My Computer and select Explore.
2. On the Tools menu, select Folder Options.

   The Folder Options dialog box appears.
3. In the View tab under Advanced settings, clear the Use simple file sharing check box.

Do these steps to turn off fast user switching in Windows XP.

1. Open the Windows Control Panel, and double-click User Accounts.
2. Click the Change the way Users Log on and Off link.
3. Clear the Use Fast User Switching check box.
4. Click Apply Options.

Internet Information Server (IIS)

The Internet Information Server (IIS) provides graphics displays and other file-based components from the HMI server on the PASS or AppServ-HMI to OWS and EWS workstations by using Web-based Distributed Authoring and Visioning (WebDAV). WebDAV is an extension to the HTTP protocol that facilitates editing and managing files across multiple users and workstations.

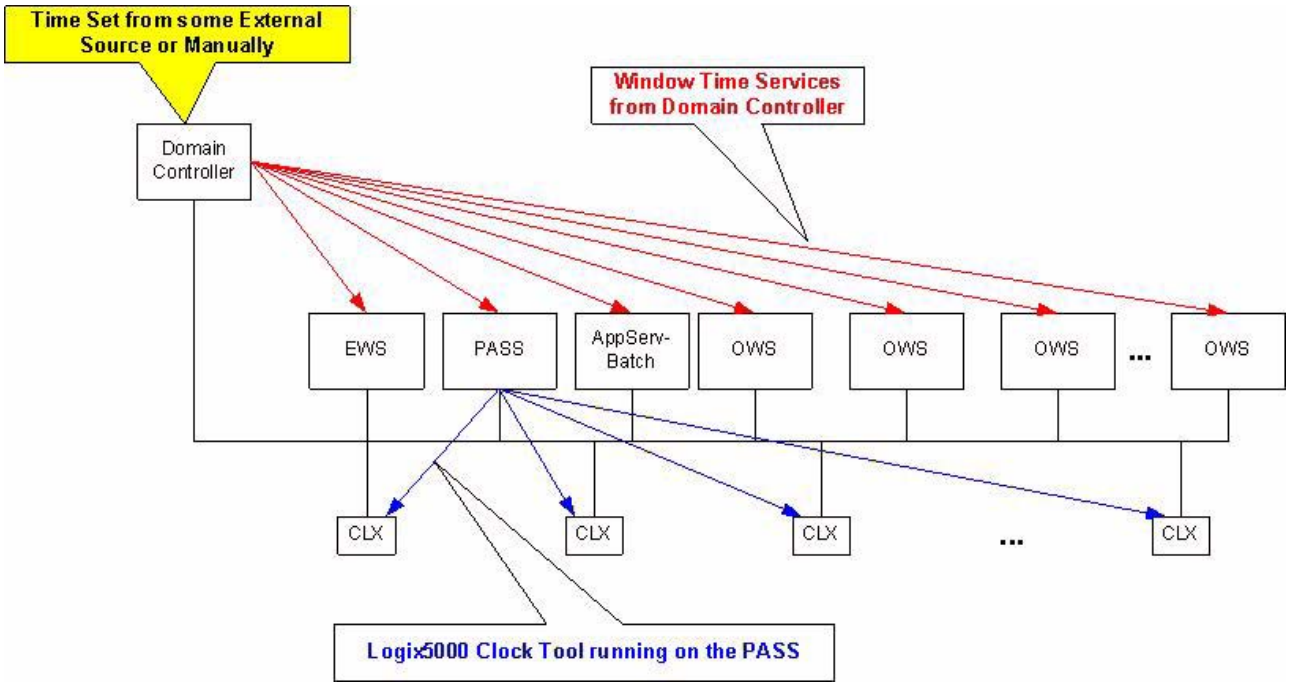
In addition, when OWS and EWS workstations issue FactoryTalk View commands that must be run on the HMI server, the commands are sent by using the IIS platform.

Therefore, the IIS software is a required component on the PASS and AppServ-HMI servers. We recommend against the installation of IIS on any other system elements.

See Chapter 2 of the FactoryTalk View Site Edition Installation Guide, publication VIEWSE-IN003, for more information.

Server and Workstation Time Synchronization

System time synchronization is important so that the internal clocks in the controllers, workstations, and servers reference the same time for any event or alarm that may occur. Configure the PASS, App-servers, OWS, and EWS to use a single server (for example, a domain controller) as their time reference and keep their clocks tightly synched to it.



Computer Time Synchronization

The Windows Time service uses the network time protocol (NTP) to synchronize computer clocks on the network from the domain controller. Each computer in the process system uses the domain controller as the authoritative time source and synchronizes their clock to it. Check the Event Viewer System log of each computer to verify that the time is updated properly.

After configuring the domain controller for time synchronization, you can use the Windows w32tm command line tool to identify any time difference between an individual computer and the domain controller. This command measures the time difference.

```
w32tm /stripchart /computer:<target>[/period:<refresh>] [/
dataonly]
```

Parameter	Identifies
`computer:<target>`	The computer to measure the offset against.
`period:<refresh>`	The time between samples, in seconds. The default is 2 s.
`dataonly`	To display only the data without graphics.

The `w32tm / resync` command manually forces a computer to resynchronize its clock to the domain controller as soon as possible and resets error statistics.

Operating System Optimization

The following recommendations will enhance the performance of your operating system:

- Turn off Windows automatic updates to prevent compatibility issues with existing PlantPAx components on your workstations.

  See Maintenance Recommendations for more information on how to apply Microsoft patches to your PlantPAx system.
- Disable operating system themes, which allow for personalized computer effects such as sounds and icons. These types of elements diminish processor speed when running some FactoryTalk View SE graphic components, such as alarm summaries.
- Disable or uninstall all third-party firewalls on a workstation before installing FactoryTalk View SE software, which is compatible only with the built-in Windows operating system firewall.
- Data Execution Prevention (DEP) should be turned on for workstations running FactoryTalk View SE components. This security feature protects against viruses and other security threats by preventing unauthorized programs from running executable program code.
- Remove Enhanced Security Configuration (ESC) from workstations running FactoryTalk View SE software. The Windows 2008 security settings protect servers by limiting how users can browse the Internet on a computer, but can hinder FactoryTalk clients connecting to application servers.
- Disable Windows error reporting.

  See page 50.

Disable Windows Error Reporting

There is an error-reporting feature included with most versions of Windows that can be used to report computer and program errors to Microsoft. However, disabling this feature will free up computer resources since Microsoft currently does not forward any error information to Rockwell Automation. We recommend that this feature be disabled on PlantPAx servers and workstations.

Do these steps to disable error reporting on an individual computer.

1. To open the System Properties dialog box, choose Start/Setting/Control Panel/System.
2. On the System Properties dialog box, select the Advanced tab and click the Error Reporting button.

   The Error Reporting dialog box displays.
3. Select the default Disable error reporting option.

   If you don't want to see any type of error message, clear the But Notify Me When Critical Errors Occur check box.
4. Click OK twice.

To disable Error Reporting on multiple computers in a Windows domain environment, use the Group Policy Editor for the domain. The policy settings are located in Computer Configuration/Administrative Templates/System/Error Reporting.

When you configure these policy settings, they will override any adjustments to error reporting that are made via the Control Panel procedures.

Virtualization

Virtualization breaks the dependency between operating system and physical hardware, allowing multiple virtual machines to run different operating systems and applications from varying locations on the same server. You also have the ability to upgrade hardware without replacing the operating system on individual workstations.

Rockwell Automation supports virtualization on VMWare's ESXi architecture for the PASS, EWS, OWS, and application servers.

Contact a Rockwell Automation Support Representative for more information.

Network Recommendations

The Ethernet network provides the communication backbone for the supervisory network for the workstations, servers, and the controllers.

- Configure all communication interfaces to operate at 100 MB, full duplex (do not use autonegotiate) for 10/100 network adapters.
- Disable power saving for the Network Interface Card (NIC) that connects a workstation to other devices on the network. The power-saving feature turns off the network card when not in use and this may interfere with network throughput.
- If multiple DCOM protocols are installed and set up on a workstation, to make sure that DCOM communications function correctly, remove all protocols other than TCP/IP.
- Use static IP addresses.
- Consider cable type for environmental conditions.

Type	Details
Fiber-optic	• Long distances • Near high magnetic fields, such as induction-heating processes • For extreme high-noise environments • For poorly grounded systems • For outdoor applications
Shielded twisted pair	• Use Category 5e, 6, or 6a cables and connectors • Use termination sequence 568A for industrial applications

Refer to these publications for additional information:

- For fiber cable specifications and an example of dB loss, see Appendix C in the EtherNet/IP Modules Installation Instructions, ENET-IN002.
- For selecting architecture, see the EtherNet Design Considerations Reference Manual, publication ENET-RM002, or the PlantPAx Selection Guide, publication PROCES-SG001.

Ethernet Switches

The supervisory network should have managed switches that direct specific messages to multicast groups. Do not use unmanaged switches. The behavior of an unmanaged switch is to flood multicast packets to all ports within the same VLAN.

- The first switch that Rockwell Automation equipment touches should have IGMP snooping enabled. IGMP snooping enables switches to forward multicast packets only to ports that are part of a particular multicast group.

Select the switch depending on the network functionality.

Table 16 - Ethernet Switches

If	Then	Recommended Media
• Supervisory • Routing information to other networks	Layer 3 switches • Stratix 8300 • Cisco Catalyst 3760G or equivalent • Cisco Catalyst 3750 or equivalent	Fiber(1)
• Connecting control hardware, sensors, and workstations • Isolated networks	Layer 2 switches • Stratix 8000 • Stratix 6000 • Cisco Catalyst 29xx or equivalent	1585-series copper media
High availability at switch level	Layer 3 switch • Stackwise 3760G or equivalent	Fiber(1)

(1) For uplink cables between Layer 2-3, fiber is recommended for 1 GB connectivity.

For more information, see these resources:

- Ethernet switches -- Ethernet Design Considerations Reference Manual, publication ENET-RM002.
- Ethernet switch configuration -- Converged Plantwide Ethernet (CPwE) Design and Implementation Guide, publication ENET-TD001.

Controller and I/O Ethernet Adapters

The EtherNet/IP network also supports controller downlinks and connections to remote I/O and field device interfaces.

Table 17 - EtherNet/IP Interface

Category	Product	Description
ControlLogix controller interface	1756-EN2T, 1756-EN2TR,1756-EN2F 1756-ENBT 1756-EWEB	ControlLogix EtherNet/IP scanner.
	1757-FFLD2 1757-FFLD4	EtherNet/IP to FOUNDATION Fieldbus linking device. Supports two or four H1 FOUNDATION Fieldbus networks.
	1788HP-EN2PA-R(1)	HIPROM Technologies, EtherNet/IP to PROFIBUS PA linking device. Supports redundant PA media and DLR capable Ethernet.

(1) Can be ordered directly from HIPROM Technologies; not a Rockwell Automation product catalog number.

Follow these EtherNet/IP communication module guidelines:

- Disable keying on EtherNet/IP communication modules
- Cannot bridge EtherNet/IP I/O modules across networks; I/O modules have to be in either a local or remote chassis, not bridged through backplanes
- Ethernet communication modules must be in a separate rack if you are using a rack-optimized communication format
- Use the Ethernet modules diagnostic page to monitor these fields:
  - Speed and duplex are at fixed 100/Full
  - Current CIP MSG connections are within limits
  - Current CIP I/O connections are within limits
  - Make sure there are no connection timeouts
  - Current TCP Connections are within limits
  - Packets/second counters should be within each device's capacity
  - Make sure there are no missed I/O packets
  - Make sure Ethernet module use is ≤80%
  - Media counters should be near 0 and not incrementing
  - In Error and Out Error counters should be near 0 and not incrementing
  - Rejected packet counters should be near 0 and not incrementing

Notes:

Field Device Integration Recommendations

Modern field devices, such as drives and flow transmitters, are often microprocessor-based. These smart devices provide digital data that is used for commissioning, maintenance, troubleshooting, and most importantly, control.

Smart field devices use two-way digital protocols for communication. Common field device communication options on the PlantPAx system include EtherNet/IP, DeviceNet, ControlNet, FOUNDATION Fieldbus, PROFIBUS PA networks or by using HART.

See http://www.rockwellautomation.com/solutions/process/integrationdocs.html for more information on these methods.

Additionally, many other networks and I/O protocols can be integrated into the PlantPAx system. For more information on Encompass third-party products, see http://www.rockwellautomation.com/encompass.

The following table describes what this chapter contains and where to find specific information.

Topic	Page
Device Configuration Options	55
EtherNet/IP I/O Recommendations	56
ControlNet I/O Recommendations	57
DeviceNet Recommendations	58
HART Recommendations	59
FOUNDATION Fieldbus Recommendations	60
PROFIBUS PA Recommendations	62

Device Configuration Options

There are many options for configuring field devices, including the following:

- Field device vendor tools
- Interface directly on the field device
- Handheld devices for selected field device networks or protocols
- Enterprise-wide solution by using FactoryTalk AssetCentre

FactoryTalk AssetCentre for Enterprise Solution

FactoryTalk AssetCentre software is a server-based, centralized tool that lets you manage field devices from multiple vendors, networks, and protocols from one common platform. FactoryTalk AssetCentre software leverages FDT technology that standardizes the communication interface between field devices and host systems. This allows any device to be accessed from FactoryTalk AssetCentre software regardless of the communication method.

The FDT interface also allows FactoryTalk AssetCentre software to integrate many different kinds of devices, including handheld diagnostic tools.

For more information, see the following publications:

- FactoryTalk AssetCentre Product Profile, publication FTALK-PP001
- FDT website at http://www.fdtgroup.org

EtherNet/IP I/O Recommendations

The EtherNet/IP protocol is a multi-discipline, control and information platform for use in industrial environments and time-critical applications. EtherNet/IP uses standard Ethernet and TCP/IP technologies and an open, application layer protocol called the Common Industrial Protocol (CIP). A growing number of field devices, including flow transmitters and drives, are available that support TCP/IP.

EtherNet/IP I/O Communication Options

- Configure all communication cards to operate at 100 MB, full duplex (do not use auto negotiate).
- Disable keying on Ethernet communication modules.
- You cannot bridge EtherNet/IP I/O modules across networks. I/O modules have to be in either a local or remote chassis, not bridged through backplanes.

Table 18 - EtherNet/IP Interface

Category	Product	Description
ControlLogix controller interface	1756-EN2T, 1756-EN2TR,1756-EN2F 1756-ENBT 1756-EWEB	ControlLogix EtherNet/IP scanner.
	1757-FFLD2 1757-FFLD4	EtherNet/IP to FOUNDATION Fieldbus linking device. Supports two or four H1 FOUNDATION Fieldbus networks.
	1788HP-EN2PA-R	EtherNet/IP to PROFIBUS PA linking device from HIPROM Technologies, a Rockwell Automation company. Supports redundant PA media and DLR capable Ethernet.

See the documentation listed in Additional Resources on page 10 for more information.

ControlNet I/O Recommendations

The ControlNet network is an open, control network for real-time, high-throughput applications. The ControlNet network combines the functionality of an I/O network and a peer-to-peer network, providing high-speed performance for both functions.

Setting	Details
ControlNet I/O	Maximum: • 5 controllers can have a rack-optimized, listen-only connection to the module • 64 I/O modules on a unscheduled, remote I/O ControlNet network • 80% ControlNet module use – For 1756-CN2, 1756-CN2R modules, this means 2048 I/O modules Controlnet module. – For 1756-CNB, 1756-CNBR modules, this means 1024 I/O modules per ControlNet module. • 25...50 ms RPI • Unscheduled • 20 ControlNet interface modules per controller Use 1756-CN2R module in local chassis. If changes are made to the ControlNet configuration, upload the configuration to make sure it gets backed up to the RSLogix 5000 project.

Follow these guidelines for ControlNet networks.

- When configuring the ControlNet network, select Optimize and re-write schedule for all connections.
- A ControlNet node can transmit 480 bytes of scheduled data in a single network update time (NUT).
- I/O modules on ControlNet can be unscheduled to allow adding I/O online.
- Do not use more than 80% of the ControlNet module.
- Keep SMAX and UMAX values as small as possible to improve performance.
- Do not leave any ControlNet node addressed 99 (this is the default address on some new devices).
- If changes are done to the ControlNet configuration, make sure it gets backed up to the RSLogix 5000 program by doing an upload.
- Maximum of five controllers with a rack-optimized, listen-only connection to the module.
- Maximum of 64 I/O modules on an unscheduled remote I/O ControlNet network.

ControlNet I/O Communication Options

In a PlantPAx system, the ControlNet network supports controller downlinks and connections to remote I/O and field device interfaces.

Table 19 - ControlNet Interface

Category	Product	Description
ControlLogix controller interface	1756-CN2, 1756-CN2R 1756-CNB, 1756-CNBR	ControlLogix ControlNet scanner.
	1757-FFLDC2 1757-FFLDC4	ControlNet to FOUNDATION Fieldbus linking device. Supports two or four H1 networks. Compatible with ControlLogix redundancy and redundant ControlNet media.
	1788HP-CN2PA-R	ControlNet to PROFIBUS PA linking device from HIPROM Technologies, a Rockwell Automation company. Supports redundant PA media and redundant ControlNet media.

See the documentation listed in Additional Resources on page 10 for more information.

DeviceNet Recommendations

The DeviceNet network is an open, device-level network that provides connections between simple industrial devices (such as sensors and actuators) and higher-level devices (such as PLC controllers and computers).

Follow these guidelines for ControlNet networks.

- There is a maximum of 40 nodes on a DeviceNet network.
- Size DeviceNet networks for at least 20% expansion.
- Keep DeviceNet communication modules in the local chassis. If the DeviceNet communication module is in a remote chassis, set the input and output sizes to match the data configured in RSNetWorx™ for DeviceNet™ software.
- Never have anything set to the default node address of 62 (reserved for personal computer) or 63 (reserved for new device to be configured).
- Set the scanner address to node 0.
- Auto device replace (ADR) can take devices installed with the default node address of 63 and place them in the configuration at the missing node address and download configuration parameters to the new device.

  ADR only has 1 MB worth of data. Some large drives contain 10 KB so networks may need to be split across multiple scanners. When configuring ADR, upload all network devices first so that the ADR files contain the correct configuration. For ADR, key the Vendor, Product Type, Product Code, Major Revisions, and Minor Revisions.
- Auto Address Recovery should be disabled.
- Configuration Recovery should be enabled.
- Store EDS files in a common location so they can be installed on engineering workstations.
- Create logic to monitor network health for critical applications.

- Extended attributes are explicitly messaged back instead of continually polled.
- Keep the Interscan Delay ≥ 5 ms.
- Keep data sizes to 8 bytes or less to prevent fragmentation, which reduces bandwidth.
- Set DeviceNet scanner RPI time to half the scan rate of the fastest task in the controller that uses data on that DeviceNet network, but not less than 2 ms.
- Always set the input and output words in the local chassis to the maximum number when adding the DeviceNet scanner to the I/O tree to allow for online expansion in the future.
- Use Background poll when possible.
- Keep (Foreground to Background Poll Ratio) * (Interscan Delay) > 75 ms.
- Instead of Automapping, you can DINT align data and map to the multiplier of node address:
  ((Node Address) * 2 = Local:2:I.Data[6].0)

DeviceNet Communication Options

In a PlantPAx system, the DeviceNet network connects networked control devices.

Table 20 - DeviceNet Interface

Category	Product	Description
ControlLogix controller interface	1756-DNB	ControlLogix DeviceNet scanner.

See the documentation listed in Additional Resources on page 10 for more information.

HART Recommendations

HART is an open protocol designed to provide digital data over 4...20 mA analog signals.

Follow these guidelines for connectivity to a HART I/O card.

- Only enable HART data on the channels that are capable of receiving HART data.
- Data updates are dependent on the number of channels enabled, and the interface card used (for example, if there are shared modems or dedicated modems for each channel).
- If using HART data for control, check the data quality bits.
- For controlling fast loops, use only the 4...20 mA output of the instrument for control instead of the extended HART data.

HART Communication Options

The PlantPAx system interfaces both directly and via remote I/O modules to provide a single termination point to gather analog process variables and the additional HART digital data.

Table 21 - HART Interface

Category	Product	Description
Chassis-based I/O modules	1756-IF8H, 1756-OF8H 1756-IF16H	ControlLogix analog I/O modules with the following: • Standard profiles in RSLogix 5000 software • DTMs
	MVI56-HART	ProSoft Technology, HART multi-drop communication interface module for ControlLogix system for use in FactoryTalk AssetCentre Process Device Configuration or other asset management system based on FDT Technology (IEC-62453, ISA103).
Distributed I/O modules	1734-sc-IF4H	Spectrum Controls, analog input module with HART for POINT I/O.
	1769-sc-IF4IH, 1769-sc-OF4IH	Spectrum Controls, analog, isolated input and output modules with HART for Compact I/O.
	1794-IE8H, 1794-OE8H 1794-IF8IH, 1794-OF8IH 1797-IE8H, 1797-OE8H	FLEX™ analog I/O and FLEX Ex™ analog I/O modules with the following: • Standard profiles in RSLogix 5000 software • DTMs
Multiplexers/gateways	EtherNet/IP interface	Spectrum Controls, HART I/O with an EtherNet/IP interface. See the Encompass website for Spectrum product offerings.
	Wireless HART adapter	Pepperl+Fuchs, wireless HART adapter. See the Encompass website for Pepperl+Fuchs product offerings.
Network configuration	Handheld device	Endress+Hauser, handheld configuration and diagnostic device. See the Encompass website for Endress+Hauser product offerings.

See the documentation listed in Additional Resources on page 10 for more information.

FOUNDATION Fieldbus Recommendations

The FOUNDATION Fieldbus network is a protocol designed for robust, distributed control of process control systems with field devices.

Follow these guidelines for FOUNDATION Fieldbus networks.

- The number of devices on an H1 segment depends on the following factors:
  - Area and classification
  - Power supply voltage
  - Amount of current each device consumes
  - System update time
  - Resistance of the segment cable.
- The voltage specification for the H1 segment is 9...32V DC. We recommend that you use a 24V DC Fieldbus Foundation power supply and be sure to keep the voltage above 13V DC at the farthest end of the segment.
- We recommend that you keep the H1 segment below 8...10 devices for maximum performance.

- The update time (macrocycle) for the H1 network is determined by the bandwidth that each device fills. This data is provided in the device's DD files. Typical marcocycles are 500 ms, 750 ms, 1 s.
- Terminators reduce noise on segments caused by signal reflections at the end of an open cable. One terminator on each end of the H1 trunk is needed for proper operation.
- Use power supplies and power conditioners with built-in short-circuit protection. Redundant power supplies are available.
- One, and only one, Link Active Scheduler (LAS) can be present on each H1 segment at one time. You might have one frame where a device is reporting an error, then a gap of silence; a device transmitting data, then another gap of silence; and so forth. The LAS directs this traffic. Another device can be a backup LAS.

FOUNDATION Fieldbus Communication Options

PlantPAx systems communicate with FOUNDATION Fieldbus devices through EtherNet/IP and ControlNet linking devices.

Table 22 - FOUNDATION Fieldbus Interface

Category	Product	Description
EtherNet/IP interface	1757-FFLD2 1757-FFLD4	Bridge from an Ethernet network to either two or four H1 networks.
ControlNet interface	1757-FFLDC2 1757-FFLDC4	Bridge from a ControlNet network to either two or four H1 networks; compatible with ControlLogix redundancy and redundant ControlNet media.
FOUNDATION Fieldbus network components	Power conditioning	Pepperl+Fuchs, FOUNDATION Fieldbus components, such as valve couplers, surge protectors, terminators, distributors, and power products. See the Encompass website for Pepperl+Fuchs product offerings.
	Terminators	
	Segment protection	
Configuration software	9308 series RSFieldbus software	Configure FOUNDATION Fieldbus devices.

See the documentation listed in Additional Resources on page 10 for more information.

PROFIBUS PA Recommendations

The PROFIBUS PA network connects automation systems and process control systems with field devices such as flow, pressure, and temperature transmitters.

Follow these guidelines for PROFIBUS PA networks.

- PROFIBUS PA is a master-slave network.
- The number of devices on a PA segment depends on the following factors:
  - Area and classification
  - Power supply voltage
  - Amount of current each device consumes
  - System update time
  - Resistance of the segment cable.
- The voltage specification for the PA segment is 9...32V DC. We recommend that you use a 24V DC PA power supply and be sure to keep the voltage above 13V DC at the farthest end of the segment.
- We recommend that you keep the PA segment below 24 devices for maximum performance.
- The cycle time for the PA network is determined by the bandwidth that each device fills. This data is provided in the device's GSD files.
- Terminators reduce noise on segments caused by signal reflections at the end of an open cable. One terminator on each end of the PA trunk is needed for proper operation.

PROFIBUS PA Communication Options

PlantPAx systems communicate with PROFIBUS PA devices through EtherNet/IP and ControlNet linking devices.

Table 23 - PROFIBUS PA Interface

Category	Product	Description
PROFIBUS interface	1788HP-EN2PA-R	EtherNet/IP to PROFIBUS PA linking device from HIPROM Technologies, a Rockwell Automation company. Supports redundant PA media and DLR capable Ethernet. Linking device includes power conditioning.
	1788HP-CN2PA-R	ControlNet to PROFIBUS PA linking device from HIPROM Technologies, a Rockwell Automation company. Supports redundant PA media and redundant ControlNet media. Linking device includes power conditioning.
PROFIBUS network components	Power conditioning	Linking devices have built-in power conditioning. Product is from HIPROM Technologies, a Rockwell Automation company.
	Junction boxes	Intelligent junction box PAR-JB (4 junctions) and PAR-JB6 (6 junctions) support redundancy and do not require separate power supplies. Product is from HIPROM Technologies, a Rockwell Automation company.
PROFIBUS network components	Power conditioning	Pepperl+Fuchs, PROFIBUS components, such as valve couplers, surge protectors, terminators, distributors, and power products. See the Encompass website for Pepperl+Fuchs product offerings.
	Terminators	
	Segment protection	

See the documentation listed in Additional Resources on page 10 for more information.

Batch Management and Control Recommendations

PlantPAx batch management and control includes two options for a scalable solution:

- Controller-based single unit or multiple independent unit solution (LBSM)
- AppServ-Batch for a comprehensive batch solution (FactoryTalk Batch)

Logix Batch and Sequence Manager (LBSM) is the controller-based solution consisting of controller code and visualization elements for use on Logix5000 and FactoryTalk View software.

Refer to the PlantPAx Selection Guide and Knowledgebase Answer ID 62366 at http://www.rockwellautomation.custhelp.com for more information on LBSM.

AppServ-Batch uses FactoryTalk Batch software for a comprehensive, server-based solution that leverages core Logix functionality (PhaseManager™). This chapter provides basic setup information for a comprehensive batch solution by using FactoryTalk Batch software.

The following table describes what this chapter contains and where to find specific information.

Topic	Page
FactoryTalk Batch Critical System Attributes	63
Install FactoryTalk Batch Client Components	64
FactoryTalk Batch Application Guidelines	65
Batch Guidelines for Logix	65

FactoryTalk Batch Critical System Attributes

The following critical system attributes (CSA) were used to verify performance for FactoryTalk Batch during process system characterization.

Table 24 - FactoryTalk Batch CSA

Batch Critical System Attribute	Performance
Idle state - start command	The time from the start command to the first scan of the running routine is no more than 1 second.
Running state - hold command	The time from the hold command to the first scan of the holding routine is no more than 1 second.
Running state - stop command	The time from the stop command to the first scan of the stopping routine is no more than 1 second.
Running state - abort command	The time from the abort command to the first scan of the aborting routine is no more than 1 second.

Table 24 - FactoryTalk Batch CSA

Batch Critical System Attribute	Performance
Held state - restart command	The time from the restart command to the first scan of the restarting routine is no more than 1 second.
Held state - stop command	The time from the stop command to the first scan of the stopping routine is no more than 1 second.
Held state - abort command	The time from the abort command to the first scan of the aborting routine is no more than 1 second.
Phase fail transition	The time from the phase failure initiation to the held state is no more than 1 second.
Phase transition time	The time from for one phase to complete and another to start is no more than 1 second.

Install FactoryTalk Batch Client Components

When using FactoryTalk Batch on a PlantPAx system, the FactoryTalk Batch components should be the first items installed on the PASS, AppServ-HMI, OWS, and EWS. This is because FactoryTalk Batch software version 11.00.00 requires FactoryTalk® Services Platform CPR9 SR2 to be on the workstation when it is installed, and the other Rockwell Automation Integrated Architecture components in PlantPAx System Release 2.0 require CPR9 SR3.

The following is the order that the components should be installed.

1. Install all components of FactoryTalk Batch on the Application Server HMI.

   Make sure that the Network Directory is selected for control of the batch.
2. Install FactoryTalk Batch client components on the PASS, AppServ-HMI, and OWS.
3. Install FactoryTalk Batch client and configuration components on the EWS.
4. Continue installations with the other integrated architecture components, including:
   - FactoryTalk View software on the PASS, AppServ-HMI, and OWS
   - FactoryTalk View and RSLogix 5000 software on the EWS

The FactoryTalk Batch client components are required on the PASS and AppServ-HMI to support replication of batch-related objects on the displays to the OWS. It is required on the EWS to configure the batch-related objects on the displays.

See Knowledgebase Answer ID 116925 a http://rockwellautomation.custhelp.com for more information on FactoryTalk Batch software version 11.00.00 installation and FactoryTalk Services Platforms.

FactoryTalk Batch Application Guidelines

In a FactoryTalk Batch application, follow these guidelines:

- The naming of batch phases exactly matches the phase name in the controller. For example, AREA01_PC1_PM_EP_AddA is a phase name.
- Automatic uploads and downloads satisfy most needs. There still are situations where custom code is necessary to request parameters and upload reports.
- Some phases use the transfer of control feature to change recipe parameters dynamically. The ControlLogix phase manager logic requests parameters manually using the controller PXRQ instruction.

Batch Guidelines for Logix

Use PhaseManager to develop the equipment phases in the Logix controller. The following guidelines for configuring phases apply for both FactoryTalk Batch and LBSM:

- All phase names in all of the controllers must have a unique name.
- In each phase, the running routine should keep track of what step it is executing by using a step index variable (part of the equipment phase user-defined structure).
- If you are using sequencer logic (SFC) for state logic programming, the restarting state routine must reset the running SFC back to a specific sequence step, based on which step the running SFC was in when the phase received the Hold command, and on what actions the Holding state routine took with the equipment controlled.
- If a timer runs across many phase state routines (for example, a phase that runs an agitator that does not stop when Held, but you must keep track of the time that the agitator ran), add a Prestate routine to the phase program and put the timer in there. Use an enable bit that is set and reset within the phase state routines to control it.
- For SFC, any conditional code that is required for transitions (such as a transition to the next step on a timer done) should be implemented by using separately defined phase tags as opposed to step tag attributes. This prevents errors when copying sequencer logic, because the SFC editor automatically assigns new step and transition tag names.
- Select an equipment phase action on loss of communication with an external procedure (such as a FactoryTalk Batch application). For example, select Hold.
- Equipment Module Acquire requests (phase ownership) should be cleared in the phase Resetting state.

Notes:

Maintenance Recommendations

Good maintenance practice will keep your PlantPAx system running efficiently. This chapter provides some recommendations for monitoring and maintaining your PlantPAx system.

The following table describes what this chapter contains and where to find specific information.

Topic	Page
Maintaining Your System	67
Monitoring Your System	69
Services and Support	72

Maintaining Your System

When installing PlantPAx system elements, we recommend that you use the operating systems and Rockwell Automation software and firmware versions as specified in the PlantPAx Selection Guide, publication PROCES-SG001. The selection guide specifies the optimal performance in accordance to sizing criteria.

The software versions for PlantPAx System Release 2.0 are listed on page 18.

Microsoft Updates

Microsoft releases a range of security updates, operating system, and other software updates. Rockwell Automation qualifies certain MS updates that potentially impact Rockwell Automation software products. The results of these patch qualifications are published on Knowledgebase Answer ID 35530 at http://www.rockwellautomation.custhelp.com.

We recommend that you do not apply or install Microsoft updates until they are qualified by Rockwell Automation. Before implementing qualified MS updates, you should verify them on a non-production system, or when the facility is non-active, to ensure that there are no unexpected results or side effects.

You can contact Rockwell Automation Technical Support if additional information or details are required.

Antivirus Software

It is best practice to have antivirus software installed on your PlantPAx servers and workstations. See Knowledgebase Answer ID 35330 for more information on compatibility and considerations when installing antivirus software.

Rockwell Automation Software/Firmware Updates

We recommend that you periodically review and update the available software patches and firmware updates for the Rockwell Automation components on your PlantPAx system. Before implementing Rockwell Automation updates, you should verify them on a non-production system, or when the facility is non-active, to ensure that there are no unexpected results or side effects.

For Rockwell Automation software (that is, FactoryTalk View, Factory Talk Batch, FactoryTalk Historian SE, and FactoryTalk AssetCentre), Rockwell Automation provides the Patch Validator tool. This tool verifies the current file version installed, the expected file version (based on the version of Patch Validator user), and completes installation of patch roll-up.

The Patch Validator tool is available for download via the Knowledgebase Answer ID 30393.

For Rockwell Automation firmware, Rockwell Automation provides a System Ferret tool that can be installed on the EWS to collect device serial numbers, and revisions of all devices through RSLinx® Classic software. System Ferret is available through ab.com as an Integrated Architecture Productivity Tool; see http://www.ab.com/go/iatools.

The devices and firmware listed can be compared against the latest firmware compatible with your Logix firmware version by reviewing the firmware compatibility. You also can download the latest firmware release at http://www.rockwellautomation.com/support/ControlFlash/.

Use the ControlFLASH™ Utility through RSLogix 5000 software to update firmware as documented in the ControlFLASH Firmware Upgrade Kit User Manual , publication 1756-UM105.

Considerations when Upgrading Software and Firmware

When installing a new PlantPAx system, we recommend that you use the specifications in the PlantPAx Selection Guide , publication PROCES-SG001.

When updating software or firmware versions, you should verify the impact on performance and memory utilization before implementing the upgrade on the production system. For FactoryTalk View or ControlLogix platforms, you should carefully review the release notes and verify the impact of the upgrade on performance and memory utilization.

You should also verify the compatibility of the upgraded version with the other software and operating systems in use on your PlantPAx system. Compatibility information can be found on Knowledgebase Answer ID 42682.

Another tool (http://www.rockwellautomation.com/compatibility/#/scenarios) lets you compare features and compatibilities of different products and firmware revisions. You can contact Rockwell Automation Technical Support for assistance.

Monitoring Your System

Certain system attributes can be monitored to determine the health of the PlantPAx system. The table below provides monitoring recommendations.

Table 25 - PlantPAx System Monitoring Recommendations

System Attribute	How To Monitor	Description
FactoryTalk View HMI Server Status	In FactoryTalk View Studio, in the Explorer window, right-click the HMI server's icon, and then click Server Status. You also can create a server monitoring screen as described in Knowledgebase Answer ID 44624.	Make sure the Primary server status is active. Changes made using FactoryTalk View Studio will always occur on the "active" server. If the Primary HMI server computer is or was down, then the Secondary could be the active server. You do not want your HMI server project edits to occur on the Secondary HMI server computer because the replication operation works only in one direction, from the Primary HMI server to the Secondary HMI server. If you accidently do your editing on the Secondary HMI project, when you eventually replicate the Primary HMI server project it will overwrite the Secondary HMI server project and all the editing that was done will be overwritte and lost.
Windows Event Logs	Event Viewer (Windows Administration Tools)	Browse the following logs looking for errors or warnings: • Application Event Log • Security Event Log • System Event Log
FactoryTalk Diagnostics	Event Viewer (Windows Administration Tools) or FactoryTalk Tools Diagnostic Viewer	Browse looking for errors or warnings.
IIS Logs	Default location is c:\Windows\system32\Logfiles\W3SVC1, but the actual location can be determined from the Internet Information Server Manager.	Look for return codes 400-404 or 500-503. (IIS - Troubleshooting HTTP error codes) See the Knowledgebase Answer ID 39618 at http://rockwellautomation.custhelp.com.

Table 25 - PlantPAx System Monitoring Recommendations

System Attribute	How To Monitor	Description
Server and Workstation CPU Utilization	Windows Administration Tool PerfMon (Performance Monitor) See Knowledgebase Answer ID 31196 at http://rockwellautomation.custhelp.com .	The CPU utilization for the PASS, App-Servers, and OWS computers should be 40% or less during steady-state operation. In PerfMon, CPU Utilization is \\<Computer Name>\Processor_Total\% Processor Time
Server Paging File Utilization	Windows Administration Tool PerfMon (Performance Monitor) See Knowledgebase Answer ID 31196 at http://rockwellautomation.custhelp.com . Windows Alerter and Messenger services See Knowledgebase Answer ID 64958 at http://rockwellautomation.custhelp.com .	Paging File Utilization can be found in the Microsoft Performance Monitor tool, but monitoring: \\<ComputerName>\Paging File(\??\C:\pagefile.sys)\% Usage Paging is the process of locating a page of data in physical memory that is currently not being used and transferring it to virtual memory to free up memory for active processing tasks. But, this process of moving pages of data back-and-forth between memory and virtual memory can slow down a system. Generate an alert if Paging Utilization exceeds 90 percent. See Check Paging Utilization on page 71 for details.
Controller CPU Utilization	L_CPU or RSLogix 5000 Controller Properties or RSLogix 5000 Task Monitor	Free CPU time is required to handle communications, abnormal conditions, and other transient loads. • Outside of production environment (before connecting FactoryTalk View and Historian clients), recommend 50% free CPU time. • When in production environment (while FactortTalk View and Historian are connected), recommend 25% free CPU time. We don't recommend using a continuous task. However, if one is used, it is import that system overhead time slice is set to allow for 25% space CPU capacity under normal loading.
Controller Memory Utilization	L_CPU or FactoryTalk View Predefined or RSLogix 5000 Controller	For simplex controllers, follow these guidelines: • Outside of production environment (before connecting FactoryTalk View and Historian clients), we recommend 50% free memory to support communications and handling of abnormal conditions. • When in production environment (while FactoryTalk View and Historian are connected), we recommend 30% free memory to support handling of abnormal conditions. Maintain greater than 50% free memory available at all times for redundant controllers.
Controller User Tasks (last scan, max scan, overlap)	L_TaskMon or RSLogix 5000 Task Properties Window	Make sure you are not experiencing task overlap by verifying the task overlap count is 0. Task overlap indicates that the controller may be overloaded and may not be executing as expected.
Controller Minor Faults	RSLogix 5000 Controller Properties Window	Make sure you are not experiencing any minor faults. This may slow your controller execution time or may indicate some other problem with your user logic.
Packets per second	L_CPU or RSLinx Enterprise pre-defined tags	Make sure the packets per second is less than 300 on the 1756-l7*x* controller and less than 200 on the 1756-L6*x* controller. If you have more than one data server topic pointing to the controller, you have to add the packets per second for each topic to get a total.

Check Paging Utilization

Virtual memory is the use of hard disk space to supplement the amount of physical memory (RAM) that is available to the computer. Windows cannot process data directly from virtual memory. If Windows needs to do something with data that is in virtual memory, it must move the page containing the needed data from virtual memory into physical memory. This process is called paging.

Windows must use CPU cycles and even a portion of RAM just to manage the paging process. Furthermore, hard disk access times are measured in milliseconds, as opposed to RAM access times that are measured in nanoseconds. Therefore, the paging process can waste a lot of server resources to move pages of data back and forth between memory and virtual memory.

Thrashing is a term for nearly constant paging. If the hard disk is running constantly with no visible results and a very sluggish response time, the system may be thrashing. Paging Utilization percentage can be used to indicate this condition to the user.

The appropriate Paging Utilization percentage can depend on the virtual memory setup on the server. It is best to baseline the paging file performance and set alert limits when performance significantly deviates from this baseline. For example, generate alert if Paging Utilization > 90%.

Additional Monitoring Resources

The Counter Monitor tool is installed with the FactoryTalk Services Platform (FTSP) on the PASS and AppServ-HMI. It is located on the drive where FTSP is installed under Program Files/Common Files /Rockwell/ countermonitor.exe.

Counter Monitor provides the ability to monitor the runtime values of counters and strings that are made available by network clients for diagnostic purposes. You also can use the Counter Monitor tool to take a snapshot of the current status and submit it to Rockwell Automation Technical Support.

Rockwell Automation also provides tools to collect log files for submission to technical support.

The Rockwell Software Data Client program can browse the FactoryTalk directory to see all tags in the directory. It can also get live data from any tag. The Rockwell Software® Data Client program does not automatically load the application. Before you use it, you must make sure the application is open by either opening the application from any computer with RSView® Studio or by running an RSView® SE Client™.

For more information, see these references depending on your operating system:

- Knowledgebase Answer ID 31073 - Log Reader Tool (XP, Windows 2003)
- Knowledgebase Answer ID 453900 - (Windows 7, Server 2008)

Services and Support

System Support offers technical assistance that is tailored for process automation systems. These services are available through TechConnect[SM] contracts. Some of the features include the following:

- Highly experienced team of engineers with training and systems experience
- Process support at a systems-level provided by process engineers
- Unlimited online support requests
- Use of online remote diagnostic tools
- Access to otherwise restricted TechConnect Knowledgebase content
- Technical Reference Library DVD
- 24-hour, seven days per week, 365 days per year of phone-support coverage upgrade option

For more information, contact your local distributor or Rockwell Automation representative or visit http://www.rockwellautomation.com/support.

The following terms and abbreviations are used throughout this manual. For definitions of terms not listed here, refer to the Allen-Bradley Industrial Automation Glossary, publication AG-7.1.

Add-On Instruction (AOI) An Add-On Instruction contains user-defined code that has logic encapsulated into pre-validated modules, and can be reused without modification. This lets you create standardized libraries that can both reduce project development time and support costs.

application server The application server (AppServ) is a server in addition to the Process Automation System Server (PASS) that is typically a FactoryTalk Directory client of the PASS. There could be an AppServ-HMI for a FactoryTalk View application, AppServ-Batch for a FactoryTalk Batch application, or AppServ-History for an Historian application.

architecture An architecture is a representation of a control and software system, as well as the process and discipline for effectively implementing the designs for such a system. An architecture conveys the information content of the related elements comprising a system, the relationships among those elements, and the rules governing those relationships.

characterization A characterization is the operation and collection of performance data for a representative process system to determine scalability, stability, and usability of a specific system configuration. A characterization is the following:

- Aimed at defining a complete system.
- Used to determine if the system is performing at specified level.
- Used to identify usability issues.
- Used to check and create rules, relationships, limits, and recommendations for system elements

client A client is hardware (personal computer) and software that provides an interface with a link into a system server application. In the Rockwell Automation architecture, a client is a computer loaded with runtime software.

control strategy A control strategy is a system footprint to show the complexity of the following:

- Data servers
- Information storage
- Operator interface (graphics, faceplates)
- Control code (sequence, procedure, phases)
- I/O

Control strategies are used to determine a set of comprehensive process system footprints that establish a representative system loading that can be measured to identify a process system's boundaries and limitations (implementation rules).

critical system attribute (CSA) A critical system attribute (CSA) is a customer-facing characteristic that defines or identifies whether the system is performing as expected. CSAs are specific, visible indicators of overall system performance and usability.

CSAs have specified parameters that must be maintained and that set the base operational requirements for the system. These parameters determine pass or fail (follow up) of a system test. For example, screen paint time < 2 seconds and screen refresh < 1 second.

There are many other attributes associated with system elements such as controller loading, computer loading, and network settings that must be configured properly in order to maintain system CSAs.

development software Development software is a program that is used to configure various system components and not required at runtime. For example, RSLogix 5000 software and FactoryTalk View software.

display object A display object is a functional group of display elements with animations.

engineering workstation (EWS) The engineering workstation (EWS) provides system configuration, development and maintenance functions of the PlantPAx system. The EWS contains development software, including FactoryTalk View SE Studio and RSLogix 5000 software.

FactoryTalk directory software FactoryTalk Directory software defines were system data is located to allow for quicker access. FactoryTalk Directory software provides a common address book of factory resources that are shared among FactoryTalk-enabled products.

FactoryTalk services platform The FactoryTalk Services Platform (FTSP) is a service-oriented architecture (see SOA) that delivers value through FactoryTalk-enabled products. This platform reduces the customer learning curve and project engineering time through commonality and reuse. For example, activation, FactoryTalk Directory, security, diagnostics, audit, live data, and alarms and events.

global object An object that is created once and can be referenced multiple times on multiple displays in an application.

historian An historian is a data collection system with the following components: collection, storage, compression, retrieval, reports, and analysis. Historian functions include raw sampling, compression, storage, retrieval, reconstitute, analyze, summarize, and present (reports and displays).

historical data Historical data is data that is used for the long term analysis of past operation. Historical data is typically retrieved.

Integrated Architecture (IA) Integrated Architecture (IA) is the identifying name of Rockwell Automation group of products that use Rockwell Automation core-enabling technologies. The PlantPAx Process Automation System is a defined set of IA products configured in a prescribed way to provide optimal performance as a process automation system.

operator workstation (OWS) The operator workstation (OWS) provides the graphical view and interface into the process. The workstation is a client of either a PASS or AppServ-HMI.

PlantPAx Process Automation System A defined set of standard Rockwell Automation Integrated Architecture products that are configured in a prescribed way to provide optimal performance as a process automation system.

Process Automation System Server (PASS) The Process Automation System Server (PASS) is the core PlantPAx system server allowing central administration throughout the PlantPAx system. The PASS is a required component.

RSLinx software RSLinx software is the communication driver (data server) for computer-based programs to access information in Rockwell Automation controllers. There is RSLinx Classic software and RSLinx Enterprise software. FactoryTalk View SE software uses RSLinx Enterprise software to directly access tags.

server Software component that serves data to an application (for example, data server). Typically, server software components are installed on server-class computers.

system attribute A system attribute is an operational functionality that can be manipulated or measured and is used to establish the operational boundaries or system capability. For example workstation memory, number of parameters on a screen, and number of control loops. A system attribute can be independent or dependent.

system element System element is a distinctive system entity made up of a combination of hardware and software products that support an identifiable system function or role. A system element can be manipulated to vary system operation or capability. For example, engineering workstation (EWS), operator workstation (OWS), process automation system server (PASS), controller unit (chassis, power supply, controller), an I/O unit (chassis, power supply, module).

system infrastructure System infrastructure is the commercial off-the-shelf hardware and software required to enable system elements to work together as a system. For example, network switches, computers, and so forth.

system server A system server expands the scope of a system by providing support for additional system capacity or optional system functions. For example, the Process Automation System Server (PASS) is a required component for all centralized and distributed process systems. The PASS provides central name resolution and system-wide, FactoryTalk services. The PASS provides the capability to distribute information to the OWS and add to optional application servers to increase the scope of the process system.

User -defined tag (UDT) Tags that you create once and reuse in multiple templates, multiple times.

workstation A workstation is a computer running development, configuration, and optionally maintenance software. A workstation is not a server.

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Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support/, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect[SM] support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/support/.

Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/support/americas/phone_en.html, or contact your local Rockwell Automation representative.

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